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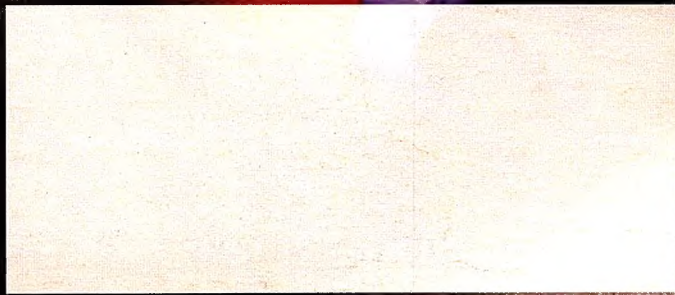
CONNECTION

THE MAGAZINE FOR NOVELL NETWORKING PROFESSIONALS

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FEATURE

6 IPv6: At the Starting Line

Although IPv6 is the protocol of the future, you probably haven't started migrating your company's network to this new protocol. This article explains why it's not too early to start planning this migration and explains how IPv6 remedies many of the inadequacies of IPv4.

NOVELL CERTIFIED PROFESSIONAL

18 NDS and DHCP: Configuring DHCP for a Complex Environment

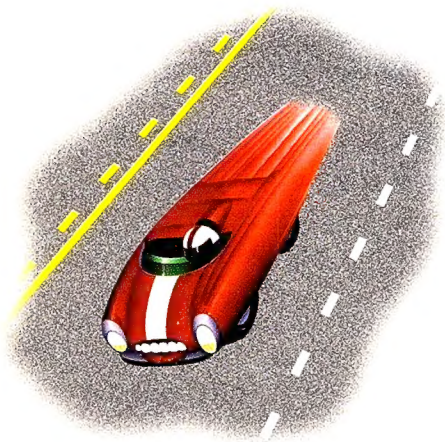
The last issue of *NetWare Connection* explained how to set up a basic Dynamic Host Configuration Protocol (DHCP) service with NetWare 5. (See "NDS and DHCP: Configuring the DHCP Service in NetWare 5," Apr. 1999, pp. 18-26.) The article in this issue explains how to configure the NetWare 5 DHCP service to accommodate a more complex environment.

32 CNE of the Year, Tom Waknitz

Novell Education presented the first CNE of the Year award to Tom Waknitz at BrainShare '99 in Salt Lake City. Find out what this talented CNE has accomplished and what he has to say about Novell certification.

34 NDS 8: Rev Up Your Directory Tree

NDS 8, the newest version of Novell Directory Services (NDS), is currently in beta testing. This highly scalable solution can support one billion objects (or more) in one directory tree, making NDS the only directory you need for enterprise networks, extranets, and the Internet. Find out what enhancements Novell has made to its already powerful directory.



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IPv6 is racing forward. Are you ready to start implementing it?

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Who are the technical experts in your neighborhood? You can meet them by joining NetWare Users International (NUI) and attending a NetWare user group meeting each month. At NetWare user group meetings, you can learn about the latest networking

products and technologies. You can also discuss networking issues with other networking professionals.

To locate a NetWare user group in your area or to get more information about NUI, visit the *NetWare Connection* web site (<http://www.nwconnection.com>). •

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42 Network Management Products

Are you spending too much time trying to manage your company's network? The network management products featured in this article may be just what you need to ease your workload.

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48 Online Connection: Get With the Program

Whether programming is your full-time profession or a hobby, you won't want to miss this month's "Online Connection." The web sites featured in this article provide the tools and information you need to write extraordinary applications. You can then amuse yourself with the new standalone and network games of the month.

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LETTERS TO THE EDITOR

Enabling FTP Services on a NetWare 4.11 Server

Congratulations to Mickey Applebaum for once again presenting a down-to-earth, straightforward article. "Enabling FTP Services on a NetWare 4.11 Server" (*NetWare Connection*, Apr. 1999, pp. 32-35) was interesting and useful. However, I did notice one small error regarding authentication after disabling anonymous access. Mickey states the following: "Unlike a workstation login to a NetWare 4.11 server, all usernames and passwords are case sensitive with Novell's FTP Service." I have Novell's FTP service installed on one of my servers, and I can successfully log in using all caps, all lowercase, or toggle case for both the user ID and the password.

Jim Parry

How About an Article About Novell Connecting Points?

I am a Novell reseller attending BrainShare '99 in Salt Lake City. I am impressed by the technology available through Novell Connecting Points—The BrainShare '99 Network. For example, this fax has been sent to the *NetWare Connection* editors directly from a Novell Connecting Points terminal using a Tobit FaxWare server.

The technology behind Novell Connecting Points is so impressive that I would like to learn more about the technology in future editions of *NetWare Connection*. As a reseller, I am always interested in real-world solutions. Novell Connecting Points is offering these solutions, not just great technology.

Michel Martin

We agree, Novell Connecting Points is a real-world solution and, therefore, a great topic for a NetWare Connection article. In fact, we are currently working on an article that explains the underlying technology of Novell Connecting Points. Look for this article in the next issue of NetWare Connection.

Using the Correct Switch for Onsite Network Analysis

I read Laura Chappell's article entitled "Onsite Analysis" (*NetWare Connection*, Apr. 1999, pp. 28-31) with great interest. Laura Chappell's writing style and ability to communicate the concepts of packet analysis continue to amaze me.

However, I did notice one oversight: Figure 2, referring to the switched network, misses one obvious point—the switch that is being used for onsite analysis must be a smart switch that is capable of forwarding all packets to the analyzer switch port. Some *NetWare Connection* readers may not realize that the type of analysis being discussed requires a switch with this feature. If a switch cannot forward all packets to the analyzer switch port, you will see only broadcast traffic from the nodes they are analyzing.

Bill Bach

You bring up a good point! The switch used to perform onsite analysis must support port spanning or mirroring in order to copy packets down to the analyzer's port. Not all switches offer this functionality.

Laura Chappell, author

Read the BrainShare '99 Conference Daily

At BrainShare '99 in Salt Lake City, the *NetWare Connection* staff edited and produced the *BrainShare Conference Daily*. We thought you might be interested in reading some of the articles, particularly the following articles from some of our favorite writers:

- "Directory and Identity: Two Sides of the Internet Coin," Dr. Eric Schmidt, Novell chairman of the board and CEO, Monday edition
- "Waiting for Active Directory: Will It Be as Great as Microsoft Claims," Gary Hein, Tuesday edition
- "Personal Directories: Seeing Things Your Way," by Glenn Ricart, Novell chief technology officer, Wednesday edition
- "shopnovell: Introducing Novell's New Internet Storefront," Kevin Millicam, Wednesday edition
- "Inside DHCP," Laura Chappell, Thursday edition

You can download these articles from the *NetWare Connection* web site (<http://www.nwconnection.com>). •

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Article Proposals. We accept articles from *NetWare* users. Please send a proposed outline via e-mail to dpearson@novell.com, or mail the outline to Debi Pearson, *NetWare Connection*, P.O. Box 970727, Orem, UT 84097-0727.

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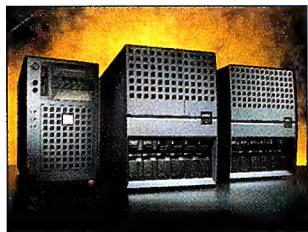


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IPv6

At the Starting Line

Cheryl Walton

Many experts predict that Internet Protocol version 6 (IPv6), also known as Internet Protocol next generation (IPng), is still years away from widespread adoption. (See Bob Metcalfe's "From the Ether," *InfoWorld*, May 18, 1998. You can download this article from <http://www.infoworld.com/cgi-bin/displayNew.pl?metcalfe/980518bm.htm>.) If these experts are right, why should you be thinking about IPv6 now? After all, you probably haven't experienced any difficulty with the old IP (now commonly called IPv4).

Although IPv6 may be a few years away from rendering IPv4 obsolete, Internet Technology (IT) experts such as Prashant Shukla, NetWare 5 product manager for Novell Inc., say the time for IPv6 is definitely coming. "The fact of the matter is IPv6 has to come," Shukla says. "There's no choice in this." IPv6 is necessary, Shukla explains, because IPv4 is no longer able to meet the demands of the rapidly expanding Internet.

The Internet Engineering Task Force (IETF)—specifically its Internet Architecture Board (IAB)—agrees that IPv6 is necessary to remedy the inadequacies of IPv4, which include too little address space and an inherent lack of security. The IETF isn't alone in its support of IPv6: IT industry leaders including Novell, Microsoft, NEC, and Cisco are also committed to the future of IPv6. In fact, IPv6-enabled products by IT companies such as Cisco are already on the market.

In other words, if you haven't given much thought to learning more about what IPv6 is, why it is necessary, and how best to go about upgrading your network to accommodate IPv6, it isn't too early to start. This article introduces you to the format of IPv6 addresses and to the different types of IPv6 addresses that are available and their purposes. In addition, this article explains the following:

- The way IPv6 address assignments make routing IPv6 addresses easy
- The structure and purpose of IPv6 packet header extensions
- Your options for converting an IPv4 network to IPv6

IPv6 ADDRESSES WIN 128-32

Who could have foreseen that IPv4's 4,294,967,296 unique addresses would prove to be inadequate? Certainly not the handful of network researchers who helped design IPv4's 32-

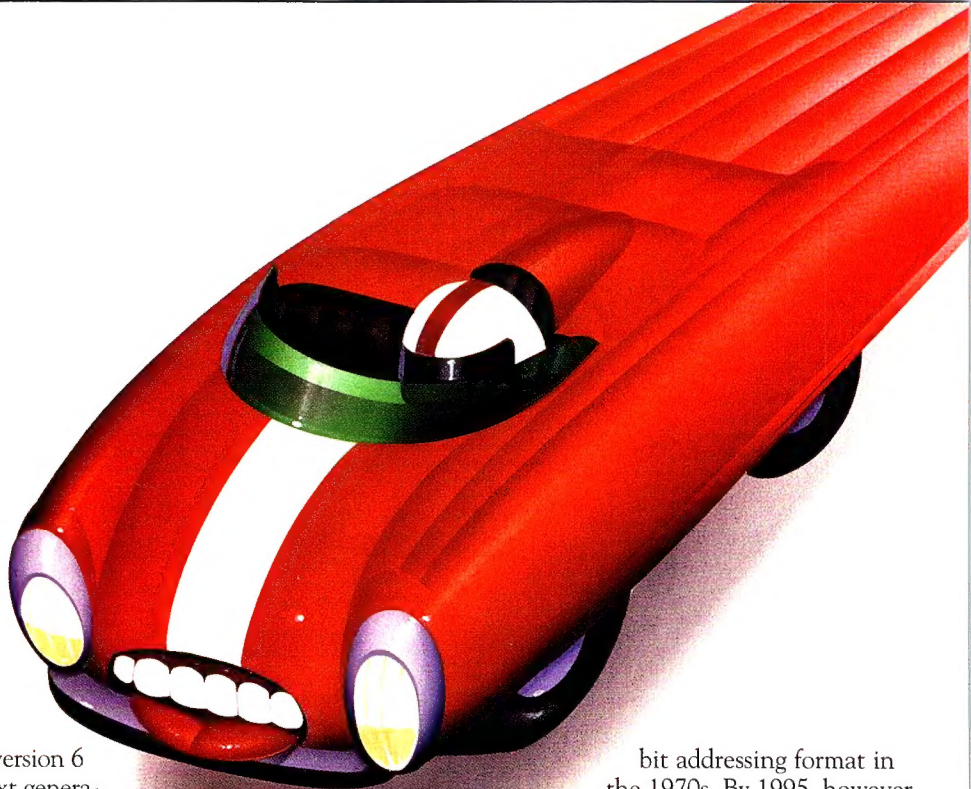
bit addressing format in the 1970s. By 1995, however, it was clear to IT professionals that IPv4's more than four billion addresses would be used up before the first decade of the 21st century. To avert the impending address shortage, the IETF went to work on a new, improved Internet protocol—one that would, among other things, provide a seemingly unlimited number of unique Internet addresses.


To solve this address shortage, the IETF approved IPv6 as a replacement to IPv4. IPv6's 128-bit addressing format provides 40,282,366,920,938,463,374,607,431,768,211,456 addresses—that's well over one undecillion addresses. According to Metcalfe's "From the Ether," one undecillion addresses translates to "more than a thousand IPv6 addresses for every square meter on the surface of planet Earth."

The new IPv6 addresses look different than the IPv4 addresses that you are used to seeing. (For a detailed discussion of IPv4 addresses, see "Choosing IP Addresses for Your Network," *NetWare Connection*, Feb. 1997, pp. 20–26. You can download this article from <http://www.nwconnection.com/feb.97/ipadd27>.) Unlike IPv4 addresses, which consist of a series of four decimal numbers connected by periods, IPv6 addresses consist of a series of eight hexadecimal numbers separated by colons. For example, a typical IPv4 address would appear as 123.45.234.56. In contrast, a typical IPv6 address would appear as 2DF1:0000:0000:5EA8:ACDE:4823:0067:ABCD.

To make IPv6 addresses easier to write, the IETF has approved a few alternative ways to represent these addresses. One alternative is to abbreviate a series of four zeros by using a single zero and to eliminate leading zeros within a series. For example, you could write the IPv6 address above as 2DF1:0:0:5EA8:ACDE:4823:67:ABCD.

Another alternative is to replace a series of consecutive zeros with a double colon. For example, the IPv6 address above can be further shortened to 2DF1::5EA8:ACDE:4823:67:ABCD. However, you can use only one double colon per IPv6 address. (For more information about how to write legal IPv6 addresses,





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download Request for Comments [RFC] 2373 from <http://ietf.org/rfc/rfc2373.txt>.)

In binary terms, each of the four numbers in IPv4 addresses are eight bits long and range from 00000000 (0) to 11111111 (255 in decimal terms). In contrast, each of the eight numbers in IPv6 addresses is sixteen bits long and ranges from 0000000000000000 (0) to 1111111111111111 (FFFF in hexadecimal terms, or 65,535 in decimal terms).

With IPv4, each host, or node, on the Internet (or on a TCP/IP intranet) is assigned a unique IPv4 address. With IPv6, each host is assigned multiple addresses. For example, an IPv6 host has, among other assigned addresses, a unique global address, which can be reached from anywhere on the Internet, and a link-local address, which can be reached only from other hosts on the same link. (For more information about IPv6 local-use addresses, see RFC 2373.)

IPv6's much larger address space and the ability to assign multiple IPv6 addresses to network hosts are just two ways IPv6 differs from IPv4. Additional features of IPv6 include the following:

- Format prefixes
- Hierarchical addressing
- Fixed-length headers
- Extension headers
- Neighbor discovery and automatic addressing

FORMAT PREFIXES

The leading bits of an IPv4 address designate its format prefix. In contrast, before the adoption of Classless Inter-Domain Routing (CIDR) the leading bits of an IPv4 address designated the address class. CIDR is the protocol that is currently used to mitigate both the wasted address spaces and the inordinately large routing tables resulting from IPv4's class-based addressing protocol. (To review Pre-CIDR IPv4 class addresses, see "Choosing IP Addresses for Your Network," *NetWare Connection*.)

The leading bits of an IPv4 address determine the type of address that follows. Likewise, the format prefix of an IPv6 address indicates the type of IPv6 address that follows. The format prefix designates that the IPv6 address is one of the following types of addresses:

- Unicast address
- Anycast address
- Multicast address
- Reserved address
- Unassigned address

Unicast Address

A unicast address is the address for a single network node. A packet sent to a unicast address goes only to the node to which the address belongs. The format prefix for unicast addresses is 001.

Anycast Address

Unlike unicast addresses, which can be assigned to any type of node, anycast addresses presently can be assigned only to routers. In addition, anycast addresses identify a set of nodes within a given topological region. For example, all of the routers on a particular network can be defined as a set of nodes. You can then assign these nodes a shared anycast address in addition to their unique unicast addresses. A packet sent to this anycast

address is routed to the node that the network routing protocol determines is nearest to the sending node.

Anycast addresses have several uses. For example, you can use an anycast address in an IPv6 routing header to send a time-sensitive packet (such as audio or video files) to the closest host that shares that anycast address. You can also use an anycast address to identify the set of routers for a specific subnet. (The IETF defines a required anycast address format for a set of subnet routers. For more information about anycast addresses for subnet routers, see RFC 2373.) The format prefix for anycast addresses (001) is the same as the format prefix for unicast addresses (001).

Multicast Address

Like anycast addresses, multicast addresses belong to a set of nodes rather than to a single node. For example, you can assign routers a shared multicast address and an anycast address. However, each node that shares a multicast address receives all of the multicast packets that are sent to that address.

Multicast addresses also have multiple uses: For example, multicast addresses are used as part of the IPv6 Stateless Address Autoconfiguration protocol, which allows hosts on intranets or on the Internet to obtain or to create their own IPv6 ad-

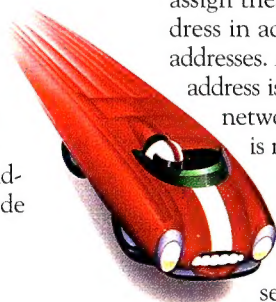
resses. (Stateless Address Autoconfiguration is explained later in this article.) The format prefix for multicast addresses is 11111111 or, in hexadecimal terms, FF. (For information about how to assign IPv6 multicast addresses to nodes on your company's network, see RFC 2373.)

Reserved Address

The IETF has reserved several predefined multicast addresses. These addresses are reserved for purposes such as news, music multicasts, and experimental purposes. (For more information about reserved multicast addresses, download RFC 2375 from <http://ietf.org/rfc/rfc2375.txt>.)

In addition to the predefined multicast addresses reserved by the IETF, the following addresses are reserved:

- **The IPv6 Unspecified Address.** Each of the 128 bits in the IPv6 unspecified address have a value of zero. (The hexadecimal representation of this address is 0:0:0:0:0:0:0:0.) Because this reserved address is actually the absence of an address, the unspecified address should neither be assigned to a node nor be used as a packet's destination. However, hosts can use this address as a source address to initialize themselves before they have configured their own unicast addresses.
 - **The Loop Back Address.** The loop back address is another reserved address that should not be assigned to a node. (The hexadecimal representation of this address is 0:0:0:0:0:0:0:1.) Packets that contain the loop back address as a destination code come back to the node from which the packet was sent. For example, you can use the loop back address to test network connections.
 - **Addresses Reserved for IPX Packets.** IPv6 includes two options for integrating IPX networks with IPv6 networks. The first option uses an address space that is reserved for IPX packets. This reserved address space enables enterprises that use the IPX network layer protocol to map their IPX addresses to IPv6 addresses. These enterprises can then send and receive packets over the Internet. The format prefix that defines these mapped addresses is 0000010. The bits following this prefix contain the mapped 80-bit IPX address.
- The second option for integrating IPX networks with IPv6 networks is to tunnel IPX packets in IPv6 packets.



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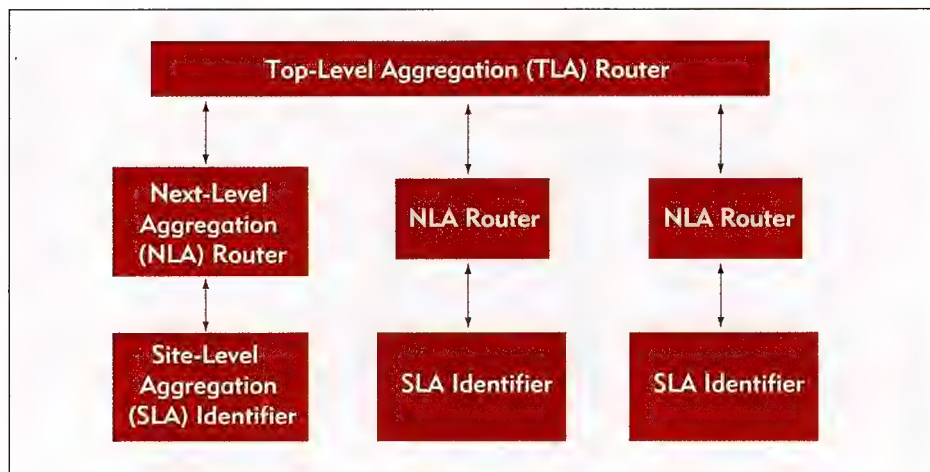


Figure 1. Hierarchical addressing makes assigning and routing IPv6 addresses more efficient.

The IETF has defined an IPv6 header extension specifically for this purpose. (This option is discussed later in the article.)

- **Addresses Reserved for Network Service Access Point (NSAP) Packets.** To facilitate the mapping of NSAP addresses to IPv6 addresses, the IETF has reserved the set of addresses with a format prefix of 0000001. Unlike IPv6 addresses, which belong to organizations rather than a physical location, NSAP addresses describe the physical locations at which a network is attached to the Internet. (For more information about the NSAP addressing protocol, download RFC 941 from <http://www.ietf.cnri.reston.va.us/rfc/rfc0941.txt>.)

Unassigned Address

According to RFC 2373, the IPv6 addresses to which format prefixes have been assigned—including unicast, anycast, multicast, and reserved addresses—account for only 15 percent of the total number of addresses available. The IETF has not assigned format prefixes to the remaining 85 percent of addresses. These unassigned addresses are set aside for future use.

HIERARCHICAL ADDRESSING

The bits following the format prefix in an IPv6 address contain information that allows IPv6 addresses to be routed hierarchically, just as country codes and area codes allow telephone calls to be routed hierarchically. For example, the bits following the format prefix of unicast addresses are divided among the following hierarchically structured identifiers:

- Top-Level Aggregation Identifiers (TLA IDs)
- Next-Level Aggregation (NLA) IDs
- Site-Level Aggregation (SLA) IDs
- Interface IDs

TLA IDs function much as country codes function within the telecommunication system. Similarly, NLA IDs function much as area codes function, SLA IDs function much as local zone codes function, and Interface IDs function much as the digits that identify individual telephone numbers.

This hierarchical design significantly reduces the number of entries routing tables must contain. For example, TLA routers need to know only the addresses of the other TLA routers on the Internet and of the NLA routers beneath them. (See Figure 1.) In contrast, IPv4 class-based addressing (without CIDR) requires top-level routers to have entries for every network on the Internet.

TLA IDs

The thirteen bits that follow the format prefix of unicast addresses contain the TLA ID. Representing 8,192 available addresses, these thirteen bits are assigned by Internet Assigned Numbers Authority (IANA) designated registries. The TLA ID is used to identify the relatively small number of large, long-haul backbone providers (such as AT&T) that exist worldwide. (For more information about the criteria for assigning TLA ID addresses, download the IETF draft "Proposed TLA and NLA Assignment Rules" from <http://www.6bone.net/tla-assign-05.txt>.)

The eight bits that follow the TLA ID space are reserved either for TLA expansion

or to add to the number of addresses in the 24-bit space that follows this eight-bit reserved segment.

NLA IDs

The 24-bit space that follows the eight-bit reserved segment contains the NLA ID. The NLA ID is used to identify the service providers whose networks are attached to TLA networks. Each IPv6 provider is responsible for assigning the next-lower addressing sequences. Therefore, TLA providers are responsible for assigning the 8,388,608 NLA addresses available within the 24-bit NLA ID space.

SLA IDs

The NLA providers, in turn, assign single addresses or blocks of addresses to individuals and companies from the 16-bit SLA ID address space that follows the NLA ID space. NLA providers can also subdivide their own 24-bit address allocation. They can then assign blocks of address space to smaller service providers. In addition, NLA providers can allocate part of their 24-bit address space to large organizations, such as government organizations, that require more than the 65,535 addresses available within the 16-bit SLA ID space.

Finally, companies that are assigned blocks of SLA ID addresses are responsible for assigning those addresses to networks and subnetworks within their organizations. IPv6 subnet prefixes are allocated out of the SLA address space. As with IPv4 subnet prefixes, IPv6 subnet prefixes are associated with one link. Unlike IPv4, however, IPv6 allows you to assign multiple subnet prefixes to any given link. For example, the subnet prefix in a link's anycast address may be just one of the subnet prefixes that identifies that link.

Interface IDs

The last 64 bits of the IPv6 128-bit address space are called the *Interface ID*. In IPv4, each host is assigned a unique number out of the total number of host addresses available within a given class-based address. In IPv6, on the other hand, interface addresses are assigned according to either the new Institute of Electrical and Electronics Engineers (IEEE) Equipment Identifier (EUI) 64 identifier or the old IEEE EUI-48 identifier. (EUI identifiers are also known as Medium Access Control [MAC] addresses.)

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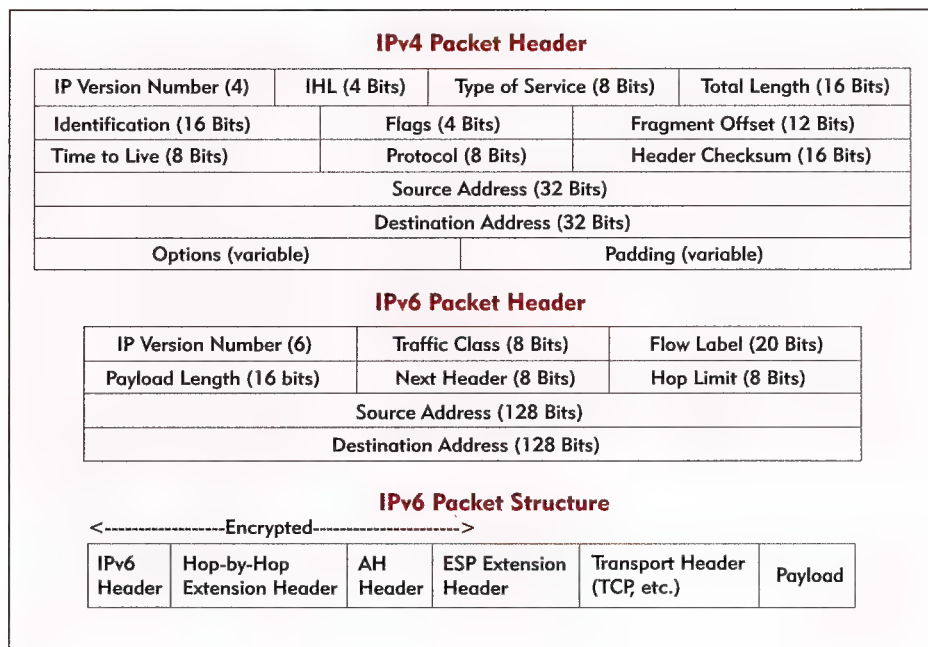


Figure 2. IPv6 significantly reduces and standardizes the number of fields in packet headers from the IPv4 format.

The new IEEE EUI-64 format is a 64-bit series of numbers. The first 24 bits in an EUI-64 number identify the manufacturer of a particular interface, and the last 40 bits identify the device itself.

For example, the first 24 bits of a router's EUI-64 identifier identify the company that manufactured the router (such as Cisco). The IEEE assigns 24-bit manufacturer numbers, and the manufacturer then assigns the following 40 bits of the router's EUI-64 identifier. (For more information about EUI-64 identifiers, download <http://www.standards.ieee.org/regauth/oui/tutorials/EUI64.html>. For information on creating EUI identifiers for IPv6, download RFC 2373, Appendix A at <http://ietf.org/rfc/rfc2373.txt>.)

FIXED-LENGTH HEADERS

Implementing a hierarchical addressing structure is just one way that IPv6 simplifies routing. Unlike IPv4, which uses variable-length packet headers, IPv6 uses fixed-length packet headers of 40 bytes. These fixed-length headers allow routers to parse packets more efficiently.

IPv6 further simplifies routing requirements by using a smaller number of header fields. IPv4 packet headers contain 14 fields; IPv6 packet headers contain only eight fields. (See Figure 2.)

Since IPv6 packets have fixed-length headers, the old IPv4 header length field

is obviously no longer needed. Other eliminated IPv4 fields include the fragment offset, identification, flags, and header checksum fields.

The most significant deletion is the IPv4 header checksum field, which contains a computation based on the total number of bits in each particular IPv4 header. Each time a router receives an IPv4 packet, the router recomputes the number of bits the header contains.

The router then checks its computation against the computation contained in the IPv4 header checksum field. If these two computations are identical, the data contained in the IPv4 header is most likely uncorrupted. In this case, the router forwards the packet. If the two computations are not identical, the router assumes the IPv4 packet is corrupted and discards it.

According to the IAB's Internet draft titled "The Case for IPv6," the IPv4 header checksum field is an unnecessary field that "has caused reduced performance in today's Internet." Because corrupted packets can be detected at both the data-link layer of the Open Systems Interconnection (OSI) model and the transport layer of the OSI model, routers do not need to check for bad packet headers. Any bad packets the data-link layer misses, the transport layer will catch. (You can download "The Case for IPv6" from <http://www.6bone.net/case-for-ipv6.txt>.)

EXTENSION HEADERS

To further enhance router performance, IPv6 transfers the functions available through the IPv4 options field to separate IPv6 headers, called *extension headers*. The IPv4 options field presents options to routers in a single, variable-length field. In contrast, IPv6 extension headers present selected options to routers in separate header fields, allowing routers to process the packets more efficiently.

IPv6 extension headers follow the primary (40-byte) header and precede the protocol header and the payload fields in IPv6 packets. (The payload fields contain the data packet being transmitted. Normally, IPv6 payload fields can accommodate up to 64 KB of data. See Figure 2.) Each extension header ends with a "next header" field that indicates whether the field following the extension header contains another extension header, the protocol header, or the payload field. (For a complete list of currently approved IPv6 extension headers, see "The Case for IPv6.")

The IETF has defined a variety of extension headers, including the following:

- Hop-by-hop extension header
- Authentication extension header
- Encapsulating Security Protocol (ESP) extension header
- IPX-in-IP extension header

Hop-by-Hop Extension Header

Because hop-by-hop extension headers are read by every router in an IPv6 packet's forwarding path, this extension header must be placed directly behind the primary IPv6 header. The hop-by-hop extension header has several uses. For example, this extension headers allows you to use the Router Alert option, which instructs all routers in an IPv6 packet's forwarding path to intercept and parse the contents of the entire packet.

You can choose this option if you are sending a Resource Reservation Protocol (RSVP) packet. RSVP instructs routers to reserve the network resources—such as maximum bandwidth or maximum delay—that are necessary to support bandwidth-intensive packets, such as those containing audio and video data, or delay-sensitive packets, such as real-time communications. (For more information about RSVP, visit <http://www.micom.com/WhitePapers/rsvp/wprsvpte.htm>.)

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The hop-by-hop extension header also allows you to use the Jumbogram option. The Jumbogram option allows you to send packets that contain payloads larger than the 64 kilobyte payload normally allowed in IPv6 packets. (For more information about the hop-by-hop Jumbogram option, visit <http://ietf.org/internet-drafts/draft-ietf-ipngwg-jumbograms-00.txt>.)

In addition, the hop-by-hop extension header provides Quality-of-Service (QoS) features. A protocol can then request the specific capabilities it needs to perform its functions from the IP network on which the protocol is operating.

Authentication Extension Header

IPv6 headers also provide enhanced security. Two of IPv6's header extensions, the Authentication Header (AH) and the Encapsulating Security Protocol (ESP) Header, work either together or separately to keep data packets secure as they travel across your company's network or the Internet.

The IPv6 AH extension header uses secret keys to authenticate the source of the packets you receive via hosts on your company's network or on the Internet. These secret keys are strings of alphanumeric characters that you configure authorized network hosts to recognize.

To prevent *spoofing* on your company's network, you can configure network hosts to recognize a secret key. You can then use an IPv6 AH extension header that uses this secret key to ensure that the information contained in IPv6 packets, such as requests for access to network resources, is from an authorized source. (*Spoofing* is the practice of configuring an unauthorized host to impersonate an authorized host to gain access to resources such as your company's confidential databases.)

The AH extension header also uses the secret key and the entire contents of the IPv6 packet to create a *message digest*. A message digest is a mathematical function (such as IPv6-approved Message Digest version 5 algorithm [MD5]) that represents the entire contents of a data packet as a single number.

This number is transmitted with the data packet. The message digest is recomputed by the host that receives the data packet. If the two message digest numbers are identical, the receiver can be reasonably sure that the data contained in the packet is uncorrupted.

The IPv6 AH extension header can protect your network from spoofing and from attempts to modify the data you receive. However, the IPv6 AH extension header cannot protect your company's network from *snooping*, which is the practice of unobtrusively reading the contents of data packets as they travel across the network or the Internet.

Snooping can risk the security of your company's most confidential data. To protect your company's information from snooping devices as it travels over the network or over the Internet, you can implement the IPv6 ESP header extension.

ESP Extension Header

The ESP extension header increases the security of your company's data by allowing you to use various encryption algorithms such as U.S. Data Encryption Standard (DES) in Cipher Block Chaining (CBC) mode and RC5. (DES-CBC is the IPv6 default encryption algorithm. RC5 is an encryption algorithm that was developed by Ron Rivest of RSA Laboratories Inc. For more information about DES-CBC, see "Securing IP," *SunWorld*, June 1998. You can download this article at <http://www.sunworld.com/swol-06-1998/swol-06-ipsec.html>. For more information about the RC5 encryption algorithm, visit <http://www.uni-siegen.de/security/krypto/rc5-rsainfo.txt>.)

You can use IPv6 ESP headers to send snoop-proof IPv6 packets in one of two modes: transport mode or tunneling mode. In transport mode, only the transport-layer header (for example, the TCP header) and the payload (the actual data being transmitted) are encrypted. In tunneling mode, a dummy IPv6 header that contains neither the packet's source nor its destination address is placed in front of the ESP header, which in turn is placed in front of the original IPv6 header. Everything behind the ESP header is encapsulated and encrypted. As a result, the entire contents of the original packet are hidden from packet-sniffing devices.

For example, you can use the ESP tunneling mode to create a security tunnel between the firewall at a remote site and the firewall at your company's headquarters. After a packet transported in tunneling mode is inside a firewall, the dummy IPv6 header and the leading ESP header are discarded. The entire original packet is then visible.

Because all portions of the IPv6 packet that follow the ESP extension header are encapsulated and encrypted and, therefore, unavailable to routers, you must insert ESP extension headers with care. For example, you should never put an ESP extension header in front of a hop-by-hop extension header because the packet will not be parsed by each router along its destination path as you intend. Because the information behind the ESP extension header, including the hop-by-hop extension header, will be encrypted, routers cannot be signaled to provide options such as RSVP. (For more information about the recommended use of IPv6 extension headers, see "The Case for IPv6.")

IPX-in-IP Extension Header

In addition to providing a way to transport confidential information via a security tunnel, IPv6 provides a way to transport IPX packets via IPv6 tunnels. The IPX-in-IP header extension allows you to transport IPX packets by encapsulating those packets within an IPv6 packet. When the IPX packet reaches the destination IPX network, the encapsulating IPv6 packet is discarded, and the IPX packet is visible to the IPX network.

DISCOVERY AND AUTOMATIC ADDRESSING

Autoconfiguration is one of the obvious advantages IPv6 has over IPv4. Autoconfiguration is a protocol that allows IPv6-enabled hosts to automatically configure and reconfigure their IPv6 addresses.

To automatically configure addresses, an IPv6-enabled host first configures an address for itself using a local network prefix and the host's own link address. (A host's *link address* is the physical address that identifies the host's Ethernet, Token Ring, or LocalTalk controller board.) The host then uses a protocol called *Neighbor Discovery* to determine whether or not this link address is unique.

IPv6 Neighbor Discovery is a function of Internet Control Message Protocol version 6 (ICMPv6), a protocol that provides services, such as error reporting, for protocols that operate at the network layer of the OSI model. Using Neighbor Discovery, a host on an IPv6 network can discover whether or not its self-configured link address is unique: The host simply

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Hexadecimal numbers	Decimal numbers
xxxxxxx	d.d.d.d
Example:	
0:0:0:0:0:134.234.07.101	

Figure 3. To facilitate migration to an IPv6 environment, IPv6 provides a way to embed IPv4 addresses within IPv6 addresses.

sends an ICMP Neighbor Solicitation multicast message to all of the hosts on the local link.

If the originating host receives no reply, its link address is unique. If another host on this local link recognizes the new self-configured link address as its own link address, this host sends the originating host an ICMP message called a *Neighbor Advertisement* message. The Neighbor Advertisement message informs the originating host that the new self-configured address is not unique. The originating host then configures another address and sends a new multicast Neighbor Discovery message to the hosts on the link.

When the host finds a unique self-configured link address, the host then sends another Neighbor Discovery multicast message that includes the host's official link address as a source address. However, rather than sending a message to all of the hosts on its local link, the host sends the message to the router that connects that link to other network links.

When an IPv6-enabled router receives a Neighbor Discovery message from a host, the router sends that host a unicast message called a *router advertisement*. A router advertisement includes information such as a valid range of addresses for the subnet to which the router and host are attached. The router also tells the host whether it must use stateful or stateless autoconfiguration.

Stateful configuration requires a Dynamic Host Configuration Protocol (DHCP) server to assign an IPv6 address to the host. If the router instructs the host to use stateful autoconfiguration, the host contacts a DHCP server with a request for a valid IPv6 address. DHCP servers assign valid IPv6 addresses dynamically—that is, each time a host makes a request, the DHCP server assigns the host IPv6 addresses from a pool of IPv6 addresses. (For more information about how DHCP

works in an IPv4 environment, see “NDS and DHCP: Configuring DHCP for a Complex Environment” on p. 18. You can also download RFC 2131 at <http://ietf.org/rfc/rfc2131.txt>.)

If the router instructs the host to use stateless autoconfiguration, the host uses information contained in the router's advertisement to generate its own address. This router-supplied information includes the numbers of the subnets associated with the host's link. The host then uses its own EUI-64 identifier to generate an interface ID for itself. Finally, the host appends the interface ID it generates to the subnet information supplied by the router. (For more information about stateless autoconfiguration, see RFC 2462 at <http://ietf.org/rfc/rfc2462.txt>.)

Autoconfiguration allows your company to change service providers without having to manually reconfigure addresses for every node on your company's network. Naturally, the bigger your company's network, the more time and money address autoconfiguration can save.

Address autoconfiguration also makes using roaming mobile hosts, such as your laptop or Internet-enabled cellular telephone, easier. Using autoconfiguration, a roaming mobile host can configure a valid IPv6 address for itself, regardless of the network to which it is temporarily attached. Using this current, temporary IPv6 address, the roaming mobile host can then ask a router on its home network (called a *home agent*) to forward packets to this newly configured address. In fact, technologies such as roaming mobile hosts may prove to be the push that starts the IPv6 ball rolling.

IT'S NEVER TOO EARLY TO MAKE A PLAN

There are a few good reasons why IPv6 is not already in wide use on the Internet. First, protocols such as Network Address Translation (NAT), DHCP, and CIDR have temporarily eased concerns about the scarcity of remaining IPv4 addresses. Thanks to these address-saving protocols, there are still 1.6 billion unallocated IPv4 addresses. (NAT allows you to make the most of hard-to-get publicly assigned Internet address assignments by mapping the privately assigned IPv4 addresses you've given to hosts on your intranet to the publicly assigned IP address of a proxy server that interacts with the Internet. This proxy server then makes Internet

connections on behalf of the non-publically assigned addresses behind it.)

Second, the change from IPv4 to IPv6 will entail upgrading everything from the government-owned Domain Name System (DNS) servers at the Internet's backbone to the routers that deliver packets from one subnetwork to another. (DNS servers map domain names to their Internet-unique addresses, a process that enables routers and switches to deliver packets to the appropriate network.)

Despite the arguments for sticking with IPv4, it's only a matter of time before IPv4's limitations make change necessary. In other words, the question isn't whether or not to upgrade your company's network to accommodate IPv6, but when and how you should upgrade your company's network.

Wait and Hurry Up

Since time-frame estimates for IPv6's widespread adoption range from two or three years (see “Light at the end of the IPv6 tunnel,” *PC Week*, Jan. 26, 1998) to as long as a decade (see “From the Ether”), you should have sufficient time to determine the best way to upgrade your company's network from IPv4 to IPv6. Your choices for managing this upgrade are simple: You can wait until the majority of Internet components (such as the DNS servers that sit on the Internet backbone and your Internet Service Provider's [ISP's] equipment) are IPv6-enabled and then upgrade to IPv6 all at once, or you can migrate to IPv6 gradually.

If you opt to wait until nearly everyone on the Internet (including your ISP) has upgraded to IPv6, you will probably need to purchase a great deal of IPv6-enabled hardware and software all at once. You will need to replace non-IPv6 compatible routers, switches, operating systems, and applications. Obviously, the more extensive your company's network, the greater the costs will be, both in terms of purchasing necessary equipment and software and in the time and effort it takes to implement this new equipment.

Although a total network overhaul may prove to be unwieldy for large companies with complicated networks, small companies may benefit from this wait-and-see approach. One of the most compelling advantages of waiting to upgrade your company's network is that many IT companies are also taking a wait-and-see approach.

According to "Spreading the IPv6 Gospel: A Tall Order" (PC Week, Nov. 16, 1998), the IPv6 stacks that are currently available for routers and operating systems are "still in development phases." This article goes on to predict that IT companies will iron out the kinks in currently available IPv6-enabled products such as routers and operating systems within the next few years.

However, whether or not you choose to wait until IT companies iron out all the kinks in IPv6-enabled products, the sooner you become familiar with IPv6 in general, the less stress this migration will cause in the long run. In fact, since IPv6-literate network consultants and programmers will almost certainly be in high demand when it becomes necessary to migrate to IPv6—and will therefore demand high prices for their services—having an IT staff that is familiar with IPv6 could save your company money and headaches.

Proceed With Caution

If you decide to migrate to IPv6 gradually, you'll have the luxury of learning IPv6 gradually. In addition, a gradual migration may eliminate late nights of trying to get your company's network up and running to meet either a self-imposed or an externally imposed deadline.

However, making a gradual transition to IPv6 will probably not be painless although IPv6's designers have worked hard to make migrating to IPv6 as easy as possible. For example, early versions of IPv6-enabled hosts and routers will use both an IPv4 stack and an IPv6 stack. These dual stacks will allow you the flexibility to upgrade your network piece-by-piece.

You may put an IPv6-enabled router on one subnet and an IPv6-enabled host on an entirely different subnet. In this case, the IPv6-enabled router will process both IPv4 and IPv6 packets, enabling IPv4 traffic to flow freely throughout your company's network. The IPv6-enabled host will also process both IPv6 and IPv4 packets, ensuring that IPv4 packets addressed to this host are not discarded. However, IPv4 hosts on your company's network will not be able to process IPv6 packets, and you will need an IPv6-enabled DNS server to send or

receive IPv6 packets over the Internet. (For more information about implementing IPv6-enabled DNS servers, see "The Case for IPv6.")

The designers of IPv6 have further facilitated the transition from IPv4 through a process called *IPv6 over IPv4 tunneling*. With IPv6 over IPv4 tunneling, IPv6 packets can reach IPv6-enabled hosts via IPv4-only networks. For example, if isolated IPv6 hosts need to communicate with one another over an IPv4 network, an IPv6-enabled router on one host's side of the network can encapsulate IPv6 packets and readdress them as IPv4 packets.

These readdressed packets are then able to traverse an IPv4 network as ordinary IPv4 packets do. When the IPv6 packets reach their destination, another IPv6-enabled router removes their IPv4 addresses and forwards them to the IPv6-enabled host to which they were originally addressed.

IPv6 also provides a standard to embed your company's IPv4 addresses in an IPv6 address. You can then continue to use the addresses already configured for your company's network until the transition to IPv6 has progressed and your company's network can readdress itself through autoconfiguration. You can embed an IPv4 address in an IPv6 address by setting all of the bits in the IPv6 address to zero, with the exception of the last 32 bits, which comprise the 32 bits of the original IPv4 address. (See Figure 3.)

If you embed your company's IPv4 addresses in IPv6 addresses until the transition to IPv6 is nearly completed, you will forgo the benefits of using standard IPv6 addresses. However, you will also avoid the necessity of manually defining the IPv4-to-IPv6 mapping procedures that tell your company's IPv6-enabled routers how to tunnel IPv6 packets over IPv4 networks. Instead, these IPv6-enabled routers can automatically tunnel IPv6 packets by converting the 128-bit IPv6 address to a 32-bit IPv4 address and vice versa.

CONCLUSION

Critics of early migration to IPv6 cite the lack of refinement in currently available IPv6 protocol stacks as one reason to adopt a wait-and-see attitude. (See "Spreading the IPv6 Gospel: A Tall Or-

der.") Advocates of IPv6 see the availability of free IPv6 protocol downloads as the logical starting point. (For example, you can download Cisco IPv6 beta software at <http://www.cisco.com/warp/public/732/ipv6/download.html>.)

Despite these diverse opinions, the widespread deployment of IPv6 may be closer than you think: Out of 20 respondents to a recent Cutter Information Corp. survey on IPv6 awareness, more than 50 percent were aware of IPv6. Furthermore, nearly 25 percent of these respondents reported that they plan to test IPv6 on their company's networks this year. (For more information about this survey, see Cutter Information Corp.'s *Corporate Internet Strategies*, Sept. 1998. You can also visit <http://www.cutter.com/cis/cistoc.htm>.) However, only you can decide how soon your company should begin the transition to the IPv6 format.

Cheryl Walton is a writer for Niche Associates, an agency that specializes in editing and writing technical documents. Niche Associates is based in Sandy, Utah. ●



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NDS and DHCP

Configuring DHCP for a Complex Environment

Dynamic Host Configuration Protocol (DHCP) is a TCP/IP service that simplifies the configuration of TCP/IP network clients. Because DHCP dynamically assigns IP addresses and client configuration parameters, you do not have to assign and track IP addresses manually. This article is the second in a two-part series that explains how to implement the DHCP service in NetWare 5. (See "NDS and DHCP: Configuring the DHCP Service in NetWare 5," *NetWare Connection*, Apr. 1999, pp. 18–26. You can download this article from <http://www.nwconnection.com/apr.99/dhcp49>.) The first article explained how DHCP works and outlined how to set up a basic NetWare 5 DHCP service. The second article explains the following:

- How to release and renew leases on Windows NT, 98, and 95 clients
- How to troubleshoot DHCP operations
- How to manage IP Address objects
- How to use Dynamic Domain Naming System (DNS), which enables DHCP to add and remove IP address mappings to the DNS database as leases are allocated and cancelled
- How to use Subnet Pool objects to enable DHCP to function on a virtual LAN
- How to use DHCP to configure various client parameters

RENEWING AND RELEASING CLIENT LEASES

In most cases, the Windows TCP/IP protocol stack automatically takes care of DHCP lease operations in the background. However, you may need to check a client's DHCP configuration or force a client to release its lease or to lease a new IP address. For example, if you move a client to a new subnet and the client persists in using its old IP address, you may need to manually fix the problem.

Windows 98 and 95 include the WINIPCFG utility, a GUI TCP/IP configuration utility, which you execute by running WINIPCFG.EXE at the Run prompt or in a command prompt window. Figure 1 shows the WINIPCFG utility after the More Info button has been clicked and the DHCP-related data is displayed. (See p. 20.)

If the client has an active DHCP lease, the WINIPCFG utility reports the lease parameters, including the IP address of the DHCP server that granted the lease, the time when the lease was obtained, and when the lease expires. If the client does not have a lease, these fields are blank, and the IP address is 0.0.0.0. If the



client has multiple network interfaces (such as dial-up Point-to-Point Protocol [PPP] connections), you must select the LAN interface in the pull-down list of adapters.

You can use the WINIPCFG utility to perform two operations:

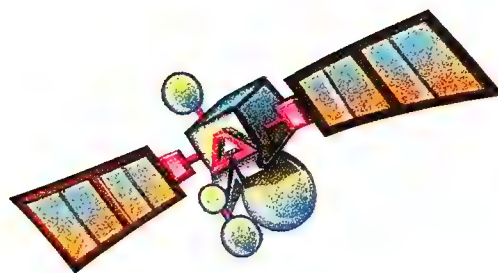
- You can click the Renew button to request a new lease or to renew an existing lease.
- You can click the Release button to cancel the current lease. The client then enters an unbound state and cannot communicate via TCP/IP until a new lease is obtained. The client transmits a DHCPRELEASE message to the DHCP server that granted its current lease. If the DHCP server receives this message, the server removes the associated IP Address object from its database and returns the IP address to the list of available addresses.

If the client has more than one LAN interface, you can use the Renew All or Release All buttons to perform the associated operation for all interfaces. However, you cannot use the WINIPCFG utility to affect an IP address that is not assigned via DHCP. For example, if a dial-up service assigned an IP address to a PPP interface, the address was not obtained through DHCP, and you cannot affect that IP address.

Windows NT includes the IPCONFIG utility, a command-line utility. (A GUI IPCONFIG utility is available in the Windows NT 4.0 Resource Kit.) If you enter a simple IPCONFIG command in a command prompt window, the utility reports only the basic client address configuration, including the IP address, subnet mask, and default gateway (router). You can use the following command options to manage the DHCP configuration:

- IPCONFIG /ALL generates a detailed report of the client's network configuration parameters. You use this option to find out which DHCP server granted the client's current lease, when the lease was granted, and when it will expire.
- IPCONFIG /RENEW attempts to renew the client's lease if one is in force or to obtain a lease if the client does not have one.
- IPCONFIG /RELEASE sends a DHCPRELEASE message to

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Figure 1. You can use the WINIPCFG utility on Windows 98 and 95 clients to view the status of DHCP leases and to release and renew leases.

the DHCP server that granted the client's current lease and cancels the client's use of the lease.

By default, the /RELEASE and /RENEW options affect all LAN interfaces on the client. You can release or renew the lease for only one interface by including the interface name in the IPCONFIG command, as shown below:

```
IPCONFIG /RELEASE E100B1
```

To learn the names of the LAN interfaces, examine the output for the IPCONFIG /ALL command.

TROUBLESHOOTING DHCP

Although a properly configured DHCP service should operate with little difficulty, problems can occur. You can use several diagnostic tools to manage DHCP. For example, you can use the DHCP debug screen on the DHCP server. To activate the debug screen, load the DHCP SRVR NetWare Loadable Module (NLM) with the -D1 parameter:

```
LOAD DHCP SRVR -D1
```

You cannot load the DHCP SRVR NLM re-entrantly. To change its operational settings, you must unload and reload the NLM.

After loading the DHCP SRVR NLM with the -D1 parameter, you can display

the DHCP debug screen by pressing the Control-Escape keys and selecting the debug screen from the Current Screens list. Because log maintenance consumes server processing power, you should enable debug logging only during the initial testing of the DHCP service and when you are troubleshooting problems.

If you use the -D1 parameter, the DHCP debug screen reports every packet exchanged between the DHCP server and client. For example, suppose that DHCP clients cannot obtain leases. If you activate the DHCP debug screen, you can determine whether or not the DHCP server is receiving DHCPDISCOVER packets from DHCP clients. If these packets are not reaching the DHCP server, one of the following problems may have occurred:

- The client is misconfigured.
- The DHCP service is misconfigured.
- Bootstrap Protocol (BOOTP) forwarding isn't enabled on intervening routers.

You should check the client's TCP/IP protocol stack to verify that the client is configured to obtain its IP address from DHCP. (For more information about configuring Windows NT, 98, and 95 clients to use DHCP, see "NDS and DHCP: Configuring the DHCP Service in NetWare 5," *NetWare Connection*.) If the client is configured properly, use the WINIPCFG or IPCONFIG utility to attempt to renew an IP address. Then examine the DHCP debug screen to determine whether or not the DHCP server received the request.

The DHCP service cannot grant leases unless it has leases to grant. You should verify that Subnet and Subnet Address Range objects have been created for the subnet on which the client resides and examine any messages that result when the DHCP SRVR NLM is loaded. Although the DHCP SRVR NLM will load if Subnet Address Range objects have not been created for a subnet, this NLM will report an error. To force the DHCP SRVR NLM to recognize new or modified Subnet or Subnet Address Range objects, you must unload and reload this NLM (or use the DNS/DHCP Management Console to pause and restart the DHCP service).

As the last issue of *NetWare Connection* explained, you must enable BOOTP forwarding on any routers that separate DHCP clients from their DHCP servers. If DHCPDISCOVER packets are not reaching the DHCP server, check the configura-

tions of the intervening routers. Also, if TCP/IP packet filtering is in effect, ensure that the router does not filter out packets for User Datagram Protocol (UDP) ports 67 and 68 (decimal), which are used for the BOOTP and DHCP services. You may want to use a protocol analyzer such as Novell's LANalyzer for Windows to examine packets on both sides of the router.

MANAGING IP ADDRESS OBJECTS

Although Subnet and Subnet Address Range objects provide the infrastructure for the NetWare 5 DHCP service, IP Address objects do most of the work. There are three types of IP Address objects:

- **Dynamic.** The DHCP service creates a dynamic IP Address object to keep track of each client lease.
- **Manual.** You can create static IP Address objects that assign particular IP addresses to specific clients. These clients are identified by a unique characteristic—usually their Media Access Control (MAC), or network hardware, addresses.
- **Exclusion.** Exclusion IP Address objects mark specific IP addresses as unavailable for assignment. The DNS/DHCP Management Console automatically creates some exclusion IP Address objects to prevent DHCP from assigning illegal addresses. You may need to create exclusion IP Address objects if you do not want specific IP addresses in a dynamic address range to be assigned.

Figure 2 shows the Addressing tab for an IP Address object in the DNS/DHCP Management Console. (See p. 22.) Because Figure 2 shows a manual IP Address object, all of the fields are active. When dynamic and exclusion IP Address objects are displayed, some fields appear but are colored gray to indicate that they are inactive. All dynamic IP Address objects are created by the DHCP service, and you cannot modify the information shown.

It is easier to discuss the fields in the following order, rather than the order in which they appear on the Addressing tab:

- **IP Address.** This field reports the IP address that is associated with the object. (This field is active for all IP Address objects.)
- **MAC Address.** DHCP clients are typically identified by their MAC addresses. (This field is active for dynamic and manual IP Address objects.)

- **MAC Type.** This field identifies the type of network that the client is connected to. DHCP packets include a hardware address type field that identifies the type of network the client is attached to. For example, MAC type 1 is associated with a 10 MB Ethernet network. (This field is active for dynamic and manual IP Address objects.)
- **Client Identifier.** A client identifier can be used to identify DHCP clients. The DHCP service generates a client identifier by appending the client's MAC type to its MAC address. Although Windows NT, 98, and 95 clients are identified by their MAC addresses, the client identifier may be useful for configuring other types of clients that are not covered in these articles.
- **Hostname.** DHCP options enable clients to send information to the DHCP server and to obtain configuration parameters from the DHCP service. The client can use the Hostname option to report its name to the DHCP service, or the DHCP service can use this option to assign a name to the client. If the

DHCP service receives a hostname from the client, this hostname is recorded in the Hostname field of the client's IP Address object. Windows NT, 98, and 95 clients include their NetBIOS names in the Hostname option. You can also enable automatic hostname generation, a feature that is discussed later in this article. (This field is active for dynamic and manual IP Address objects.)

- **Enable DNS RR Entry Updates.** You should select this field if you want to enable Dynamic DNS updates for a manual IP Address object. (This field is active only for manual IP Address objects.)
- **Associated NDS Object.** You can use this field to document the relationship between a manual IP Address object and a Novell Directory Services (NDS) object that receives its IP address from the manual IP Address object. (This field is active only for manual IP Address objects.)
- **Comments.** You can use this field to document the purpose and history of a manual or exclusion IP Address object.

The following sections discuss the characteristics of the IP Address objects.

Dynamic IP Address Objects

The Addressing tab for a dynamic IP Address object reports the IP Address that is assigned to the lease and the client identifier that is assigned to the client. This tab also reports the client's MAC address, MAC type, and hostname.

The Usage tab for a dynamic IP Address object reports whether the client lease is permanent or timed. If the lease is timed, the Usage tab reports the date and the time the lease expires.

You cannot modify the information on the Usage tab. To define the lease expiration properties, you use the Subnet Options tab for the Subnet object associated with the IP address.

You can do very little to affect a DHCP lease from the server side. Although you can delete the IP Address object associated with a lease, this action can create problems because the client can continue to use the IP address until the T1 or T2 interval occurs. At that time, the client will

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The screenshot shows the 'Addressing' tab of a configuration window. It contains the following fields and values:

- IP Address:** 192.168.1.10
- Assignment Type:** Manual (selected from a dropdown)
- Client Identifier:** 01:00:A0:C9:22:E8:DD
- MAC Type:** 1 Ethernet (10 Mb) (selected from a dropdown)
- MAC Address:** 00:A0:C9:22:E8:DD
- Hostname:** Win98Lab
- ☐ **Enable DNS RR Entry Updates**
- Associated NDS Object:** (empty text field)

Figure 2. The Addressing tab for an IP Address object

attempt to renew the lease. (For more information about the process of requesting leases, see "NDS and DHCP: Configuring the DHCP Service in NetWare 5," *NetWare Connection*.) Only then will the client discover that the lease has been lost.

However, if you delete a dynamic IP Address object for an active lease, the IP address is immediately available for re-assignment. The DHCP server can then offer the IP address to a new client. Since the old client is still using the IP address, communication errors can occur.

In practice, a Windows client generates an Address Resolution Protocol (ARP) request to determine whether the IP address the client has been assigned is being used by another device. If the client discovers a conflict, it will not bind IP to an IP address that is already being used. However, some clients will not attempt to obtain a different DHCP lease and will display an error message that requires user intervention. (This behavior can be eliminated by applying the Winsock 2 patch to Windows NT, 98, and 95 clients. The client can then discover an IP address conflict, send a DHCPDECLINE message, and try to obtain a different IP address.)

Unfortunately, DHCP will continue to offer this same IP address in response to subsequent DHCP client requests. Until you force the client that owns the lease to release the IP address, new clients will have difficulty obtaining a functional IP address. Before you delete an IP Address object, you should force the client associated with that object to release its lease.

Manual IP Address Objects

In addition to obtaining an IP address from DHCP, clients can obtain a variety of configuration parameters, called *DHCP options*. For example, suppose that you

need to change the address of the default router on a subnet. Without DHCP, you must visit each IP device and manually edit its default router parameter.

With DHCP, you can simply make the change on the DHCP server. Clients that lease their IP addresses will obtain the change the next time they renew their leases. Only clients that do not lease an IP address require manual intervention.

Because dynamic IP addresses are dynamic, you cannot be certain that a client will have the same IP address from one week to the next. However, some devices require fixed IP addresses. For example, DNS servers must have fixed IP addresses so clients can include these IP addresses in their configuration. Manual IP address objects enable you to use DHCP to configure devices that require fixed IP addresses.

To create a DHCP object, you must be logged in with a user account that has the Create right for the container object in which the DHCP object will be placed. To create a manual IP Address object, use the DNS/DHCP Management Console to complete the following steps:

1. Select the DHCP Service tab.
2. In the object tree on the left side of the DNS/DHCP Management Console, select the Subnet object for the subnet that contains the IP address you want to define.
3. Click the Create button in the toolbar.
4. In the Create New DHCP Record dialog box, select IP Address, and click the OK button.
5. The Create IP Address dialog box appears. Select Manual in the Assignment Type list box. The dialog box displays the fields shown in Figure 3. (See p. 24.)
6. Complete the dialog box as follows:
 - **IP Address.** Enter the IP address to

be assigned to the client.

- **Define Additional Properties.** Check this box if you want to examine the detail parameters of the IP Address object after it is created.
- **Client Identifier.** For Windows NT, 98, and 95 clients, leave the default setting in this field.
- **MAC Type.** In most cases, you can use the default setting, FF Any, for this field. The DHCP server then responds to requests from DHCP clients on all types of physical networks. If desired, select the type of network to which the client is connected.
- **MAC Address.** Enter the client's MAC address using the format appropriate for the type of network to which the client is attached. In most cases, the format consists of two-digit (16-bit) hexadecimal fields separated by colons. You can use the WINIPCFG or IPCONFIG utility to determine the MAC address of a Windows NT, 98, or 95 client.

After you create the manual IP Address object, you can edit all of the detail parameters, except the IP address. To change the IP address, you must delete the manual IP Address object and recreate it.

Because a client does not learn of any changes until it renews its DHCP lease, you should avoid configuring manual IP Address objects with permanent leases. If the lease duration is permanent, the client will update its DHCP options only when the computer is restarted or when the lease is manually renewed.

Exclusion IP Address Objects

Some types of devices cannot function as DHCP clients. For example, at present all NetWare servers must be configured with static IP address parameters. In such cases, you should define exclusion IP Address objects that prevent these static IP addresses from being assigned to DHCP clients. A static IP address can be part of a range of dynamic addresses that is defined by a Subnet Address Range object.

As mentioned earlier, the DNS/DHCP Management Console also automatically creates exclusion IP address objects to prevent the DHCP service from assigning prohibited IP addresses to clients. For example, the host ID part of an IP address cannot be all 0s or all 1s. The DNS/DHCP Management Console creates exclusion IP Address objects to ensure that clients



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Create IP Address

IP Address: 192 . 168 . 1 . 10

Assignment Type: Manual

☐ Define Additional Properties

Client Identifier: 00:00:00:00:00:00

MAC Type: FF Any

MAC Address: 00:A0:C9:22:E8:DD

Create Cancel Help

Figure 3. You use this dialog box to define a manual IP Address object.

cannot obtain these IP addresses.

On the network 192.168.1.0 with the subnet mask 255.255.255.0, the DNS/DHCP Management Console creates exclusion IP Address objects for 192.168.1.0 and 192.168.1.255. The exclusion IP Address objects may appear under a Subnet Address Range object if the subnet address range includes the static IP address.

To define an exclusion IP Address object, complete the following steps:

1. In the object tree of the DNS/DHCP Management Console, select the Subnet object for the subnet that contains the IP address you want to define.
2. Click the Create button in the toolbar.
3. In the Create New DHCP Record dialog box, select IP Address, and click the OK button.
4. The Create IP Address dialog box appears. Select Exclusion in the Assignment Type list box. The dialog box adjusts to display the fields shown in Figure 3.
5. Enter the IP address in the IP Address fields, and click the OK button.

After you create an exclusion IP Address object, you can modify only the Comments field on the object's details page. You should use this field to describe the purpose of the object. For example, you may identify the device that uses the IP address. (Interestingly, I have been unable to convert an object that is created as an exclusion IP Address object to a manual IP address object, but I have successfully converted manual IP Address objects to exclusion IP Address objects and back.)

SUPPORTING DYNAMIC DNS

A relatively recent addition to the DNS and DHCP specifications, Dynamic DNS enhances the value of the DHCP service. Prior to Dynamic DNS, DHCP

clients could not be assigned dynamic IP addresses if it was necessary to identify these clients in DNS. After all, DNS Address resource records are defined statically. With Dynamic DNS, however, DHCP can update Address resource records as client leases are granted and revoked.

Of course, to implement Dynamic DNS, you must be familiar with DNS administration. For more information about DNS, read "NDS and DNS: Configuring DNS Services in NetWare 5" (*NetWare Connection*, Feb. 1999, pp. 29–38) and "The DNS Service in NetWare 5: Going Beyond the Configuration Basics" (*NetWare Connection*, Mar. 1999, pp. 30–37). (You can download these articles from <http://www.nwconnection.com/past.>)

Dynamic DNS has one fundamental limitation: All clients that receive their IP addresses from the same DHCP subnet are placed in the same DNS domain. If your company's DNS domain name space includes subdomains, such as subdomains for individual departments, you must design your network subnets so that each department has its own DHCP subnet.

Apart from that precaution, Dynamic DNS is quite easy to implement. The procedure is as follows:

1. Create any required DNS forward- and reverse-naming zones.
2. Define the required DHCP Subnet and Subnet Address Range objects.
3. Select a DHCP Subnet object to display its detail page. The Dynamic DNS parameters are found on the Addressing tab. To configure Dynamic DNS, complete the following fields:
 - **DNS Zone for Dynamic Update.** Select the DNS zone that is to receive Address resource records that DHCP creates for this subnet.
 - **Domain Name.** Specify the domain or subdomain in which Address re-

source records will be created for this subnet. The domain name in this field must be the same as or a subdomain of the domain defined in the zone identified in the DNS Zone for Dynamic Update field. For example, suppose that the user's computer name is blythe and the value of the Domain Name field is eng.pseudo-corp.com. Dynamic DNS creates an Address record for blythe.eng and places this resource record in the pseudo-corp.com zone, resulting in an effective DNS name of blythe.eng.pseudo-corp.com.

4. Click the Save Data to NDS button in the toolbar, and respond to the prompt to save the changes.
5. Select the Subnet Address Range object that is used to dynamically assign IP addresses for this subnet.
6. Select one of the following options in the Range Type field:
 - **Dynamic DHCP.** DHCP uses a host name supplied by the client (via DHCP option 12) to create DNS Address records. This option is preferred if only Windows NT, 98, and 95 clients will access the subnet since all Windows clients send their NetBIOS names to DHCP. This option also works for other clients that send their names to the DHCP server.
 - **Dynamic BOOTP and DHCP.** This option supports Dynamic DNS using computer names supplied by the client. This option also enables support for BOOTP clients on the subnet.
 - **Dynamic DHCP with Automatic Hostname Generation.** This option supports clients that do not send a computer name to DHCP. A DNS name is generated by appending the client's IP address as a suffix to the name specified in the Auto Hostname Starts With field. If a client does supply its name, that name will be used to create the DNS Address record.
7. Click the Save Data to NDS button in the toolbar.
8. Restart the DHCP service.

If you activate Dynamic DNS with automatic hostname generation enabled, the DNS/DHCP Management Console populates the DNS database with a range of Address resource records. For example, if the value of the Auto Hostname Starts With field is Pseudo and the Subnet Address Range starts with address

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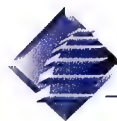
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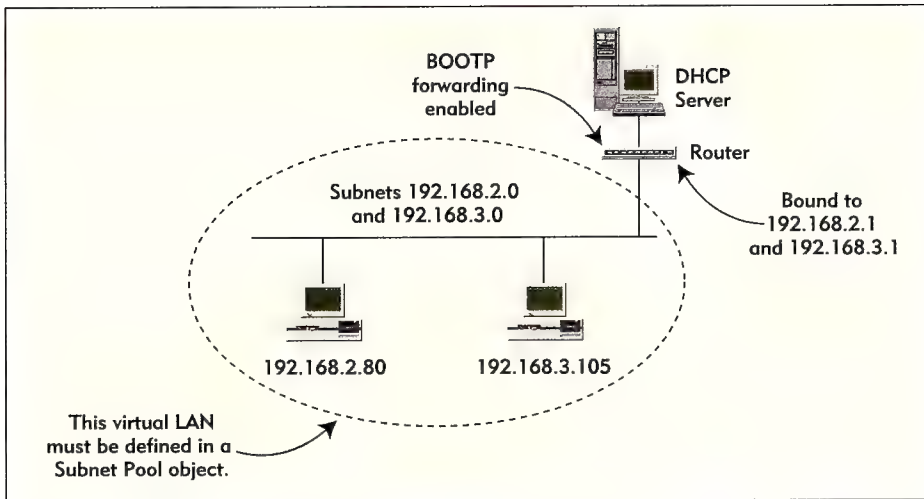


Figure 4. This network incorporates a VLAN and requires DHCP Subnet Pool objects.

192.168.1.25, an Address resource record is created with the hostname Pseudo_192_168_1_25. As you can see, a user must know the device's IP address to determine the automatically generated DNS name.

In addition, DHCP clients may change their IP addresses from time to time, so their automatically generated DNS name may change as well. Consequently, the preferred technique is to use DHCP option 12 hostnames whenever possible, a capability that is always used with Windows NT, 98, and 95 clients and can be enabled on most other DHCP clients.

USING SUBNET POOL OBJECTS

Subnet Pool objects solve a specific problem. They enable DHCP to assign IP addresses to clients attached to virtual LANs (VLANs), which are network segments that are associated with more than one IP address range. Before you learn how to configure Subnet Pool objects, you need to understand why and when these objects are required.

Requirements for Subnet Pool Objects

Figure 4 depicts a network that incorporates a VLAN. Notice that the router interface that attaches to the bottom network is bound to two IP addresses, 192.168.2.1 and 192.168.3.1. (The subnet mask is the default for class C networks, 255.255.255.0.)

Devices on that network segment can be assigned IP addresses for networks 192.168.2.0 and 192.168.3.0. These two class C subnets are logically distinct from one another. Device 192.168.2.80 cannot communicate directly with device 192.168.3.105 because the devices are attached to

separate IP subnets. To exchange packets, these devices must communicate through a router.

Suppose that subnets 192.168.2.0 and 192.168.3.0 are defined in DHCP Subnet Pool objects. Also suppose that Subnet Address Range objects are created so addresses are available on each subnet for dynamic assignment. As Figure 4 shows, the DHCP server is not directly attached to these networks. DHCP clients on the VLAN communicate with the DHCP server using the BOOTP forwarder on the router. This configuration has important consequences.

When a DHCP client initializes on the network, it does not have an IP address. The client does not even know the IP subnet to which it is attached. Consequently, the client must identify itself using its hardware address, and the client can send messages only to the general broadcast address of 255.255.255.255.

However, broadcast messages do not cross routers, and an IP device cannot communicate with a device on a remote subnet using only the remote device's hardware address. Until the client is assigned an IP address, no communication can take place directly between the DHCP client and the DHCP server.

The BOOTP forwarder acts as an intermediary. When a DHCP client on the VLAN broadcasts a DHCPDISCOVER request to obtain an IP address, the BOOTP forwarder intercepts the request and passes it on to the DHCP server. To enable the DHCP server to determine the subnet from which the request originated, the BOOTP forwarder includes with the forwarded request the first IP address that is bound to the interface from which the

DHCPDISCOVER packet was received. In the case of the network in Figure 4, that address is 192.168.2.1. The DHCP server responds by offering an IP address lease on subnet 192.168.2.0, which the BOOTP forwarder passes on to the DHCP client.

This scenario works until the DHCP server exhausts the addresses available on subnet 192.168.2.0. IP address leasing then comes to a halt. Because the BOOTP forwarder does not keep track of active DHCP leases, it does not know that leases are exhausted for subnet 192.168.2.0. Consequently, the BOOTP forwarder continues to supply its first bound IP address of 192.168.2.1 in all DHCPDISCOVER packets forwarded to the DHCP server.

In addition, the DHCP server has no knowledge of the network topology. As a result, the DHCP server is unaware that clients on the network segment can be assigned IP addresses from subnet 192.168.3.0 as well as from subnet 192.168.2.0.

Subnet Pool objects notify the DHCP server that two or more Subnet objects are associated on a VLAN. When subnets 192.168.2.0 and 192.168.3.0 are pooled, the DHCP server knows that it can allocate IP address leases from subnet 192.168.3.0 when all the available addresses on subnet 192.168.2.0 have been leased.

Managing Subnet Pool Objects

To create a Subnet Pool object, use the DNS/DHCP Management Console to complete the following steps:

1. Create a Subnet object for each IP subnet on the VLAN. These Subnet objects should be functionally equivalent, offering the same lease duration, DHCP options and Dynamic DNS support.
2. Create a Subnet Address Range object for each subnet on the VLAN. These Subnet Address Range objects should also be functionally equivalent.
3. Click the Create button in the toolbar, and select Subnet Pool from the Create New DHCP Record dialog box.
4. Complete the Create Subnet Pool dialog box as follows:
 - **Subnet Pool Name.** Supply a descriptive name for the Subnet Pool.
 - **Select NDS Context.** Specify the NDS context in which the Subnet Pool object is to be created.
5. Click Create.

Now you can assign Subnet objects to the pool. For each Subnet object in the

subnet pool, complete the following steps:

1. Select the Subnet object in the object tree to display its detail parameters.
2. In the Subnet Pool Reference field, select the subnet pool to which the subnet will belong.
3. Click the Save Changes to NDS button in the toolbar.

After all of the required Subnet objects have been added to the subnet pool, you must stop and then start the DHCP service to activate the changes.

SUPPORT FOR DHCP OPTIONS

DHCP options provide a convenient way to centrally manage a variety of TCP/IP configuration parameters. This section explains how to enable the NetWare 5 DHCP service to support these options.

You can assign DHCP options at three different levels:

- **Global DHCP Options.** You can define global DHCP options that provide default values for all clients on all subnets. Global options are useful when configuring settings that apply to all clients such as the addresses of the organization's DNS servers.
- **Subnet DHCP Options.** You can define DHCP options for specific Subnet objects. Subnet options override any corresponding global DHCP options and are useful for configuring settings that are unique to a subnet.
- **IP Address DHCP Options.** You can define DHCP options individually for manual IP Address objects. Options assigned to manual IP Address objects override corresponding options that are assigned globally or to Subnet objects.

You should begin by defining global DHCP options that will apply to all DHCP clients. For example, if all clients use the same DNS servers, you can enter the addresses of the DNS servers as global DHCP options. If you have defined a Service Location Protocol (SLP) directory agent that will be used by all clients, you can add the Directory Agent DHCP option as a global DHCP option.

To define global DHCP options, complete the following steps:

1. Click the Global Preferences button in the DNS/DHCP Management Console toolbar.

2. Click the Modify button in the Global Preferences dialog box to open the Modify DHCP Options dialog box. (See Figure 5 on p. 30.) The Selected DHCP Options list shows the active options.
3. To add a DHCP option to the Selected DHCP Options list, select the option in the Available DHCP Options list, and click Add. To remove a DHCP option, select it in the Selected DHCP Options list, and click the Remove button.
4. To configure the parameters for a DHCP option, select the option in the Selected DHCP Options list. The lower part of the Modify DHCP Options dialog box changes to display data entry fields appropriate for the option. Some options accept a single value that can be entered into the field provided. Most options accept multiple values that must be added individually. A variety of operations are supported with options that accept multiple values:

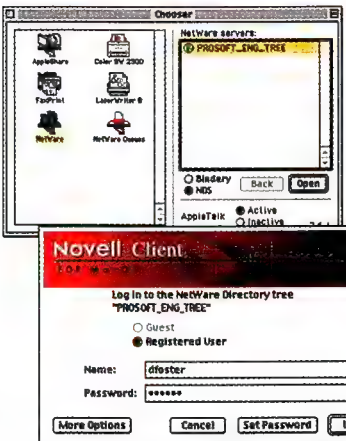
- To add a value to the list, click the Add button to open a dialog box that accepts data appropriate for the option.

- To remove a value, select the value, and click the Delete button.
 - For some DHCP options, you can edit individual parameters by selecting the parameter and clicking the Update button to open a dialog box.
 - For some DHCP options (such as the Directory Agent option shown in Figure 5 on p. 30), the parameters must appear in the order of preferred use. To adjust the position of a parameter, select it, and click the Up or Down buttons.
5. After you have added and configured all required DHCP options, click the OK button. DHCP options that have not been configured with parameter values are not saved. The DHCP options, along with their parameters, are listed in the Global DHCP Options tab of the Global Preferences dialog box.

After you define global DHCP options, you can define DHCP options for Subnet and manual IP Address objects. To do so, select the object in the object tree of the DNS/DHCP Management Console. In the

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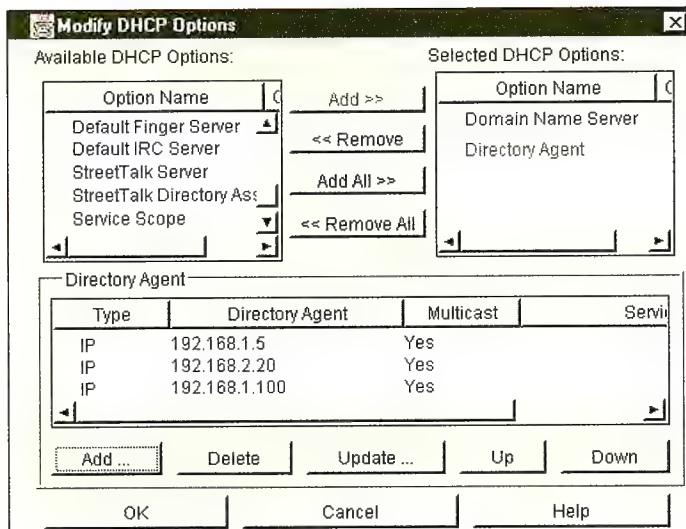


Figure 5. You use this dialog box to configure DHCP options.

object detail pages, select the Other DHCP Options tab, and click the Modify button to open the Modify DHCP Options dialog box. You can then configure DHCP options you want to use.

COMMON DHCP OPTIONS

You can configure dozens of DHCP client options. In fact, the set of DHCP options is extensible, and Novell has defined a variety of options that are of particular interest to NetWare administrators. Supported DHCP options are discussed briefly in the *Novell DNS/DHCP Administrator's Guide* that is included in the NetWare 5 online documentation. This section describes the options that are most significant to NetWare 5.

Windows NT, 98, and 95 clients use only a few of the available DHCP options. You should be aware of the following:

- **Router (Option 3).** This option specifies a list of one or more IP addresses that the client will use as default routers.
- **Domain Name Server (Option 6).** This option specifies a list of one or more IP addresses of DNS servers.

Two options apply to NetWare/IP and the NetWare 5 IPX compatibility mode. These options are discussed in Request For Comments (RFC) 2242. (You can download this RFC from <http://www.ietf.org>.)

- **NetWare/IP Domain Name (Option 62).** This option specifies the name of the NetWare/IP domain.
- **IPX Compatibility (Option 63).** This option supports suboptions to configure

NetWare/IP client parameters. (For information about these suboptions, see Table 2-6 in *Novell DNS/DHCP Administrator's Guide*.)

To configure clients to participate in IPX-compatibility mode networks, you can use three NetWare 5 suboptions for option 63. IPX-compatibility mode supports IPX-dependent applications on pure IP networks:

- **IPX Network Number (Option 63-12).** This option specifies the IPX network number of the compatibility mode network.
- **IPX Stale Time (Option 63-13).** This option specifies a minimum time in minutes that must expire before the client attempts to renew its migration agent address information. This option applies when the client is configured to discover migration agents dynamically.
- **Migration Agents (Option 63-14).** This option specifies a list of IP addresses that identify migration agents available to the client. If the client is not configured with the IP addresses of a migration agent, the client uses dynamic discovery to identify these agents.

You can configure SLP clients with a variety of new DHCP options:

- **Directory Agent (Option 78).** This option specifies the IP addresses of statically defined SLP Directory Agents.
- **Service Scope (Option 79).** This option specifies the names of any SLP scopes in which the client will participate.

Space does not permit this article to discuss the proper use of each of these options. For more information, consult the following resources:

- RFC 2132 describes most of the standard DHCP options. (You can download this RFC from <http://www.ietf.org>.)
- "Migrating to Pure IP" (*NetWare Connection*, Sept. 1998, pp. 34-37) discusses the compatibility mode network and

its use when supporting legacy IPX applications. "Service Location Protocol" (*NetWare Connection*, July 1998, pp. 32-37) describes the SLP support in NetWare 5. (You can download both of these articles from <http://www.nwconnection.com/past>.)

- *Novell's Guide to NetWare 5 and TCP/IP* (Drew Heywood, Novell Press ISBN 0-7645-4564-7) includes chapters on SLP and the configuration of the compatibility mode support, including information that was unavailable when the articles listed above were written.

Configuring DHCP Clients to Use DHCP Options

When clients are to be configured using DHCP options, you must clear the corresponding parameter in the client's static configuration settings. Any parameters that are statically defined at the client take precedence over parameters that are received from DHCP options.

Clients exert significant control over the DHCP configuration process and do not necessarily accept settings defined in DHCP options. For example, the T1 and T2 intervals that determine when leases must be renewed are defined by settings in the registries of Windows NT, 98, and 95 clients. Although DHCP options can be configured to specify the T1 and T2 intervals (options 58 and 59 respectively), these DHCP options have no effect on Windows clients. If your network includes clients that are not supported by the NetWare 5 client software, you should review the specifications of the clients' TCP/IP protocol stacks to determine their specific behaviors with regard to DHCP.

CONCLUSION

This article ends a series of four articles that discuss the fundamentals of managing the NetWare 5 DNS and DHCP services. These services are fairly complex, and the space available forced me to examine their features selectively. However, the information in these articles should be enough to get you started.

Drew Heywood is a network administrator who currently spends most of his time writing books and articles about networking. His latest book is *Novell's Guide to NetWare 5 and TCP/IP*, written for Novell Press. Drew holds CNE and MCSE certifications.

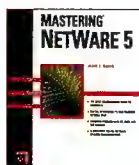
Drew would like to thank Chuck Flood of Novell for his help. Chuck provided technical advice and reviewed the finished article. ●



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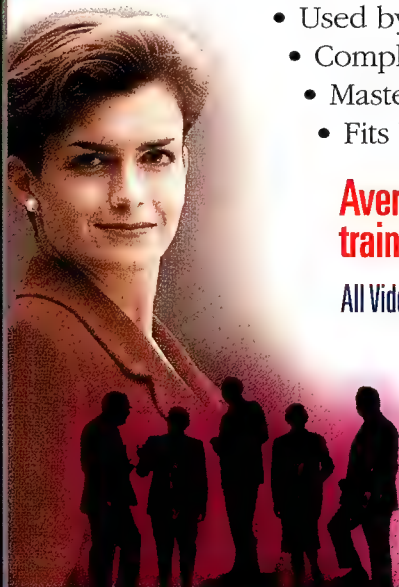
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CNE of the Year Tom Waknitz

In front of a packed audience of CNEs and IT professionals at BrainShare '99, Roger Blomgren, vice president of Novell Education, presented the first annual CNE of the Year award to Tom Waknitz. Waknitz is an incredibly talented CNE who currently works at GE Capital IT Solutions.

WAKNITZ'S FIRST EXPERIENCE WITH NETWARE

Waknitz first heard about NetWare while researching a way to connect multiple Computer Aided Drafting (CAD) systems together: "In my research to connect our CAD systems together, I ran into this software called Novell NetWare. Then I started to learn that I could use NetWare and this stuff called thick coax to actually hook these computers up, as opposed to the six-port serial black box I had put in place. Suddenly, I was the guy that could help engineering talk to materials and accounting to purchasing, and they could all print to a couple of shared printers. Thus [I began] a career for myself that to this day is still both very challenging and creative. I spent the next two years helping build and maintain that first computer network."

After learning more about NetWare at a few other jobs, Waknitz knew that certification would open the door to exciting career opportunities. Waknitz says, "I was hooked. I needed to take a job as a real LAN administrator. I knew that to gain credibility in this field, I needed to be certified. I could see it in both my salary and customer comments. I was good at what I did, but the industry wanted certified staff to complete the installs."

CERTIFICATION: THE SECRET TO WAKNITZ'S SUCCESS

Waknitz attributes his success to his Novell training and certifications. "I feel that [Novell certifications] are the cornerstone of my success. I personally have realized more than a 100 percent increase in my salary from 1995 to 1999 because of my certifications. Believe me, the pay increase is nice, but there is no better feeling than being the guy in the room with all the certifications and the knowledge to use a Novell solution to solve a problem."

SO WHERE IS WAKNITZ NOW?

Waknitz is currently the Novell Business Development Manager for GE Capital IT Solutions. Waknitz continues to learn and to earn certifications. In fact, he holds the following certifications: CNE and Certified Novell Administrator (CNA) for NetWare 5, intraNetWare, and NetWare 3; Enterprise Certified Novell Engineer (ECNE); Master CNE for Connect and Mes-



Roger Blomgren, Tom Waknitz, Richard Nortz

saging; and Certified Novell Instructor (CNI) and Master CNI. In addition, Waknitz is a Certified Novell Salesperson (CNS).

Waknitz manages a highly respected and accomplished team of Master CNEs who implement Novell solutions. Waknitz says: "Today I manage six systems engineers dedicated to the design, installation, and configuration of the Novell product line. These six guys are the best anywhere because we have a few simple rules: You take a class at an NAEC or complete a self-study program, you take the test to stay certified, and you teach each other what you know about how these products work." His team's motto is "Information is knowledge, knowledge is power, and with that power we intend to make Novell king!"

SUCCESS STORY

Waknitz has managed the installation of NetWare and Novell Directory Services (NDS), GroupWise, ManageWise, BorderManager, Zero Effort Networks (Z.E.N.works), and NDS for NT for several organizations including schools, government institutions, and private corporations. On one occasion, a large company had hired a systems engineer who was not trained and not certified to install and configure NetWare 4.11, NDS, and GroupWise 5.2. Because of some major problems with the installation, this company asked Waknitz and his team to help out.

Waknitz explains, "After several months of working on this install, the company was unable to get NDS and GroupWise to perform how management knew [these products] could perform. Although this network was really a mess and things were not working, [the problems] stemmed from the fact that the original systems engineer had no training! When I came on the scene, it was very easy for me to see the solutions that needed to be implemented. The information we learned in the Novell courses and testing for certification gives us the knowledge to understand how Novell products work. This knowledge gives us the power to implement the solutions that solve business needs today and in the future."

WHAT IT TAKES TO BE CNE OF THE YEAR

For more information about the criteria Novell Education used to choose the CNE of the Year and for additional success stories, visit <http://education.novell.com/certinfo/success.htm>. ●



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NDS 8

Rev Up Your Directory Tree

Do you want to save your company thousands of dollars in network management costs? This is not a rhetorical question. You can actually save your company thousands of dollars by consolidating your network databases into a single directory—Novell Directory Services (NDS).

Over the years, Novell has evolved NDS into a solution that enables you to manage your entire enterprise network—including users, groups, printers, applications, workstations, proxy servers, firewalls, bridges, routers, and more—from a central location. The next generation of NDS, called *NDS 8*, provides a highly scalable, standards-based solution that makes NDS the only directory you need for enterprise networks, extranets, and the Internet. NDS 8 for the NetWare platform, which is currently in beta testing, is available for downloading from <http://support.novell.com/beta/public>. (NDS 8 cross-platform support will be available in the near future.)

WHAT IS NDS 8?

NDS 8 delivers the reliability, manageability, and security of earlier versions of NDS and provides the following additional benefits:

- Unlimited scalability
- Standards-based, native Lightweight Directory Access Protocol (LDAP) 3
- Directory importing and exporting capabilities based on LDAP Data Interchange Format (LDIF) 1
- New and improved ConsoleOne management tool
- Internet-ready security

Unlimited Scalability

NDS 8 incorporates an underlying database that greatly improves the performance and scalability of NDS, enabling you to store at least one billion (possibly more) objects in one directory tree. As a result, NDS 8 supports millions of more objects than competing directories support.

As Novell demonstrated at BrainShare '99 in Salt Lake City, NDS 8 provides scalable performance, regardless of how many objects the directory tree contains and how quickly objects are added to the directory tree. During a BrainShare '99 general session, millions of network objects were added to a directory tree until the tree contained one billion users. As the objects were being added to the directory tree, NDS 8 performed search queries with consistent speed. With other directories, the time



it takes to perform search queries increases in direct proportion to the number of objects stored in the directory tree.

One billion objects in a single directory tree may seem unreal or even unnecessary. However, current business trends show that an increasing number of companies are using the Internet to connect their employees to customers, partners, suppliers, and so on. To connect these virtual business communities, known as *extranets*, companies require a massively scalable directory such as NDS 8. Because NDS 8 supports a virtually unlimited number of objects, NDS 8 is also a viable directory for Internet service providers (ISPs), telephone companies, and other large enterprises that support thousands or even millions of customers.

Native LDAP 3

Because NDS 8 includes native LDAP 3, NDS 8 can interoperate with LDAP-based directories and applications. Although earlier versions of NDS supported LDAP, this support was provided via an LDAP gateway that you had to install separately. Because LDAP is native in NDS 8, you do not have to separately install an LDAP gateway.

NDS 8 also supports auxiliary classes as defined by the LDAP specification. Auxiliary classes enable you to extend the attributes, or properties, of a single object without having to extend the base class from which the object was derived. For example, suppose that you want to add a new attribute to the Debi User object. To add the new attribute in earlier versions of NDS, you would have to add the attribute to the base class for User objects. You would then add the attribute to all User objects in the directory tree.

With auxiliary class support in NDS 8, however, you can add an attribute to only the Debi User object. You do not have to change the base class for User objects. Auxiliary classes in NDS 8 are dynamic: You can associate auxiliary classes with objects, or you can remove the attributes on the fly.

NDS 8 also supports additional naming attributes for User objects, which are defined in the LDAP 3 specification. In

addition to the standard NDS cn= naming attribute, NDS 8 supports the following:

- Unique Identifier (UID) naming
- DNS naming support, dc=

These attributes for User objects increase the interoperability between NDS and LDAP-based directories. For example, these attributes enable the NDS tree structure to resemble the structure of other LDAP-accessible directories and enable you to perform LDAP queries on these attributes.

Directory Importing and Exporting Capabilities

To help you build directory trees that contain millions or even billions of objects, NDS 8 supports LDIF 1, an emerging Internet standard that is currently in draft form before the Internet Engineering Task Force (IETF). LDIF 1 describes a file format for importing and exporting directory information between LDAP-based directory servers.

NDS 8 includes the BULKLOAD utility, which enables you to use LDIF files to add, delete, or modify objects in your directory tree. You can create LDIF files in the following ways:

- Manually create an ASCII file in LDIF format.
- Use an LDIF-generation utility to generate an LDIF file.
- Export directory information from an LDAP-based directory.

New and Improved ConsoleOne

Now that your company's directory tree contains millions of objects, how do you manage it? NDS 8 includes ConsoleOne 1.2, an entirely new and significantly improved client-side management tool. If you have used ConsoleOne in NetWare 5, the first thing you will notice about the new version of ConsoleOne is that its performance has been improved significantly. In addition, the features provided by ConsoleOne 1.2 are on par with the features provided by the NetWare Administrator (NWADMIN) utility.

Although you can still use the NWADMIN utility to manage an NDS 8 tree, Novell recommends that you use ConsoleOne 1.2. Novell makes this recommendation because ConsoleOne 1.2 can effectively gather and display the contents of large container objects. When you browse

a container object that contains thousands of objects, ConsoleOne 1.2 retrieves and displays the contents of the object one page at a time. The NWADMIN utility, on the other hand, gathers all of the contents of the container object before displaying the information. As a result, using the NWADMIN utility to browse large directory trees can be quite cumbersome.

You should also consider using ConsoleOne 1.2 because Novell has announced that ConsoleOne is its management strategy for the future. In addition, ConsoleOne 1.2 supports a snap-in architecture that enables new features and functionality to be added to the management console. As your company's network expands and you need to manage diverse hardware and software or third-party network components and systems, new capabilities can be added to ConsoleOne 1.2, enabling you to manage the components.

As a pure Java application, ConsoleOne is a cross-platform solution and is easily extensible to the web. In fact, Novell has indicated that the next release of ConsoleOne will snap into the web.

If these reason don't convince you to use ConsoleOne 1.2, the new feature set will. These features include the following:

- **Enhanced Search Capabilities.** ConsoleOne 1.2 allows you to use complex search queries. For example, you can search for objects that have Supervisor rights to the [Root] of the directory tree.
- **Manage All NDS Objects.** ConsoleOne 1.2 provides all of the object management capabilities found in the NWADMIN utility. You can create, move, rename, delete, and modify all objects in the tree. You can also modify attributes of multiple objects simultaneously.
- **Simplified Rights Management.** ConsoleOne 1.2 enables you can to manage all object and property rights as well as file system rights and attributes.
- **Schema Extension Capabilities.** You can use ConsoleOne 1.2 to extend the NDS schema to accommodate new types of objects and properties in the directory tree.
- **LDAP Management.** You can use ConsoleOne 1.2 to configure LDAP services,

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to manage LDAP mappings, and to control LDAP access to the directory tree.

Internet-Ready Security

When you create an extranet, you must connect outside, authorized individuals—such as customers, partners, and suppliers—to resources on your company's protected network. The directory that you use to connect these users must provide a high level of security and access control. Can you think of a directory that provides better security and access control than NDS? Probably not.

NDS has always offered authentication services that are highly secure. NDS 8 offers additional security features that help ensure a secure environment as your private network extends to support e-commerce, extranets, and the Internet. These features include the following:

- Full integration of Secure Sockets Layer (SSL) to provide secure Internet access
- Enhanced support for public key infrastructures (PKI) and cryptography
- Support for X.509v3 certificates and smart cards

COMPATIBILITY IS NOT AN ISSUE

If you have installed NDS updates before, I am happy to tell you that compatibility is not an issue with NDS 8. The NDS versions that are required to run a mixed NetWare 4 and NetWare 5 tree (NDS 5.17 or higher) are the same versions required for NDS 8. If your directory tree is NetWare 5 compatible, you can install NDS 8, and it will perform seamlessly.

However, you should be aware of a few caveats: First, if a replica ring includes multiple versions of NDS, the features offered will be limited to the lowest common denominator in the replica ring. (A replica ring includes all of the servers that hold copies of a given partition.)

For example, if some servers in a replica ring are running NDS 5.17 or 6.02 and you add a server that is running NDS 8, the replica ring will be bound by the limitations of the earlier versions of NDS. In short, if you want to fully leverage the enhancements in NDS 8, all of the servers in a replica ring should be running NDS 8.

Second, if some servers in the directory tree will continue to run a previous version of NDS, you must run an updated version of the DSREPAIR utility on one of these servers to ensure schema compatibility with NDS 8.

INSTALLING NDS 8 STEP-BY-STEP

To install NDS 8, you must complete the following steps:

1. Download the current release of NDS 8, NetWare Support Pack 2, the updated DSREPAIR utility, and Novell International Cryptography Infrastructure (NICI) 1.2 for NetWare 5.
2. To ensure schema compatibility in the directory tree, run the updated DSREPAIR utility on servers that you will not upgrade to NDS 8.
3. Install NetWare 5 Support Pack 2.
4. Install NICI 1.2 if you plan to use this security cryptography service.
5. Install NDS 8.
6. Install ConsoleOne 1.2.

Downloading the Files You Need

Before installing NDS 8, you will need to download the following:

- **NDS 8.** NDS 8 includes DS.NLM, DSLOADER.NLM, DSI.NLM, NLDAP.NLM, ConsoleOne 1.2, and the NWADMIN utility. As this article goes to press, NDS 8 is in open beta. You can download NDS 8 from Novell's Beta Program web site (<http://support.novell.com/beta/public>). After the beta testing is completed, you will be able to download the final version of NDS 8 from Novell's Software Downloads web site (<http://www.novell.com/download>).
- **NetWare 5 Support Pack 2.** You must install this support pack on NetWare 5 servers that will run NDS 8. As this article goes to press, NetWare 5 Support Pack 2 is also in open beta. You can download this support pack from Novell's Beta Program web site (<http://support.novell.com/beta/public>). After the beta testing is completed, you can download the support pack from Novell's Support Connection web site (<http://support.novell.com/misc/patlst.htm>).
- **Updated DSREPAIR Utility.** You can download the updated DSREPAIR utility from Novell's Beta Program web site (<http://support.novell.com/beta/public>). After the beta testing is completed, you will be able to download the final version of the DSREPAIR utility from Novell's Software Downloads web site (<http://www.novell.com/download>).

Updated versions of the DSREPAIR utility are provided for NetWare 4.10,

NetWare 4.11, and NetWare 5. If some servers in the directory tree will continue to run previous versions of NDS, you must run the DSREPAIR utility on one of these servers to extend the schema.

- **NICI 1.2 for NetWare 5.** If you plan to use NICI, you must install NICI 1.2, which contains updates that make NICI compatible with NDS 8. You can download NICI 1.2 from <http://www.novell.com/products/cryptography>.

Installing and Running the DSREPAIR Utility

If the directory tree contains NetWare 4.10, NetWare 4.11, or NetWare 5 servers that will not be upgraded to NDS 8, you must run the DSREPAIR utility on one of the servers that contains a replica of the [Root] partition. For example, if a replica of the [Root] partition is stored on a NetWare 4 server and a NetWare 5 server, you should run the DSREPAIR utility on one server or on the other, but not on both.

The server on which you run the DSREPAIR utility will then propagate the schema changes to all of the other servers in the directory tree. You must complete this step before installing NDS 8.

To ensure that the servers running previous versions of NDS are compatible with NDS 8, complete the following steps:

1. Double-click the 4X5XREPEX.E file in Windows or type the filename at a DOS prompt. After the file is expanded, you will see a NetWare 4.x and a NetWare 5 DSREPAIR directory.
2. Copy the appropriate DSREPAIR.NLM to a server that contains a replica of the [Root] partition of the directory tree. For example, if you will be running the DSREPAIR utility on a NetWare 5 server that contains a replica of the [Root] partition, use the DSREPAIR.NLM in the NetWare 5 directory.
3. Load the DSREPAIR.NLM at the server console.
4. Select the Advanced Options menu.
5. Select the Global Schema Operations option.
6. You are prompted to authenticate to the directory tree. Enter the login name and password for ADMIN or a user with equivalent rights.
7. Select Post NetWare 5 Schema Update. The NDS schema is then updated.

Installing NetWare 5 Support Pack 2

NetWare 5 Support Pack 2 provides updates to services included with NetWare 5, related protocols, and the NetWare 5 operating system itself. When you install the support pack, the installation program checks the version and the date of each file copied to the server. Newer files are not overwritten.

You must complete the following steps before installing NetWare 5 Support Pack 2 on the NetWare 5 server:

1. Unload the JAVA.NLM and all Java applications on the NetWare 5 server. The JAVA.NLM and the java class libraries can then be updated.
2. If you are running an IP-only environment, load IPXSPX.NLM. This NLM is required to successfully install NetWare 5 Support Pack 2.
3. Record current SET parameter values on the NetWare 5 server. NetWare 5 Support Pack 2 resolves a problem with the registry. This fix resets all SET parameters to the NetWare 5 default values. To record modified SET parameters, complete the following steps at the server console:
 - a. Load the CONLOG NLM.
 - b. Type Display Modified Environment. The information displayed on the screen is saved in the SYS:\ETC\CONSOLE.LOG file. You can use this file to reset the SET parameters after NetWare 5 Support Pack 2 is installed.
 - c. Unload the CONLOG NLM.

After you have completed these steps, you can install NetWare 5 Support Pack 2 by completing the following steps:

1. Double-click the NW5SP2.EXE file in Windows or type the filename at a DOS prompt.
Note: Because the NW5SP2.EXE file contains directory path names that exceed the DOS 8.3 limits, you should extract this file in a root-level directory on your workstation hard drive or on a NetWare volume that accepts longer path names.
2. Load NWCONFIG at the server console.
3. Select Product Options.
4. Select the Install a Product Not Listed option.
5. Press the F3 key. Specify the directory path in which you expanded the files,

and press the Enter key.

6. Indicate the file groups you want to install. If you want to uninstall NetWare 5 Support Pack 2 at a later time, you should also select the option to back up files. The old files are then copied to SYS:\SYSTEM\BACKKSP2.
7. Press the F10 key to accept the marked options. The installation program begins to copy files.
8. After the files are copied, you should review the .NCF files for accuracy.
9. Restart the server by typing the following command at the server console:

RESTART SERVER

Installing NCI Updates

The NCI updates provide enhancements to the NCI Modules such as Novell PKI and Novell SSL. (For more information about NCI, see "With NCI It's All Holes Barred," *NetWare Connection*, Dec. 1998, pp. 8–20. You can download this article from <http://www.nwconnection.com/dec.98/nicid8>.) To install the NCI updates on the NetWare 5 server on which you plan to use NCI and LDAP, complete the following steps:

1. Double-click the NCI-UO.EXE file in Windows or type the filename at a DOS prompt.
2. Load NWCONFIG at the server console.
3. Select Product Options.
4. Select the Install a Product Not Listed option.
5. Press the F3 key, and specify the directory path in which you expanded the files. If you expanded the files to a floppy diskette, press the Enter key.
6. The Software License screen appears. Accept the License Agreement. The installation program begins to copy files.
7. When the installation is completed, press the Enter key.
8. Restart the server by typing the following command at the server console:

RESTART SERVER

Installing NDS 8

After you have downloaded NDS 8, you must complete the following steps before installing it on a NetWare 5 server:

1. Run the DSREPAIR utility as described in the "Installing and Running the DSREPAIR Utility" section on p. 36.

2. Close ConsoleOne and the DSREPAIR utility so that the files are properly updated.
3. Mount all volumes. NDS 8 updates all trustee rights. If a volume is not mounted when NDS 8 is installed, the trustee assignments for that volume will be lost.

After you complete the above steps, install NDS 8 on a NetWare 5 server by completing the following steps:

1. Double-click the NDS 8 file in Windows or type the filename at a DOS prompt.
2. Load NWCONFIG at the server console.
3. Select Product Options.
4. Select the Install a Product Not Listed option.
5. Press the F3 key. Specify the directory path in which you expanded the files, and press the Enter key.
6. If you have not installed the updated NCI files, you are prompted to exit the installation program and install these

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files if you require ephemeral key support for SSL connections. If you do not require this support, press the Enter key to continue the installation.

7. The Novell License Agreement page appears. Press Escape to continue. Then select the Accept License Agreement option.
8. The NDS 8 README file is displayed. After reading the file, press the Escape key to continue. The installation program begins to copy the NDS 8 files.
9. After the files are copied, the NetWare 5 server automatically reboots. The NDS 8 installation then automatically continues by updating the NDS schema.
10. After the NDS schema has been updated, a message appears, telling you to ensure that all volumes are mounted so that the trustee assignments for those volumes are properly updated. If you have not already mounted all volumes, do so before continuing.
11. Press the Enter key to continue. The installation program updates the trustee assignments.
12. You are then prompted to authenticate to the directory tree with supervisory rights to the directory tree. Enter the login name and password for the ADMIN user or a user with equivalent rights.
13. After the installation is completed, the installation log file is displayed. After you read the log file, press the Escape key to continue.
14. When you are prompted to restart the server, select Yes.

After the installation is completed, you must complete the following tasks:

1. Install the NWADMIN snap-in modules for Catalog Services and WAN Traffic Manager. Although the NDS 8 installation program copies updated versions of DSCAT.NLM and WTM.NLM, the installation program does not install the NWADMIN snap-in modules for managing these services. You must run the NetWare 5 installation program to install these snap-in modules. During the installation process, select No when you are prompted to overwrite the newer NLM files. Selecting Yes installs the old files over the newly installed files.
2. Run the NDS Backlinker by typing

the following command at the server console:

```
SET DSTRACE="b"
```

The NDS 8 installation program changes the internal NDS identifiers. To ensure consistency, the backlinker process has to update backlinked objects. This process will run automatically after 50 minutes. Entering this SET command forces the backlinker process to run immediately and prevents inconsistent state objects.

Installing ConsoleOne 1.2

The ConsoleOne 1.2 installation program simply installs a few necessary .DLL files to your workstation and adds the ConsoleOne program icon to your Windows desktop. The 1.2 release of ConsoleOne is designed to run the ConsoleOne program files from a server directory. You cannot install the program files on your workstation.

At the time this article was written, you could not run ConsoleOne 1.2 at the server. According to Novell, however, Java 1.1.7, which is necessary to run ConsoleOne 1.2 at the server, will be available in the near future.

The NDS 8 installation process copies a new version of ConsoleOne to the NetWare 5 server. Before installing the ConsoleOne 1.2 .DLL files and program icon to your workstation, ensure that the workstation meets the following requirements:

- A minimum of 64 MB of RAM and 64 MB of virtual memory swapper space
- 200 MHz or greater processor
- Windows NT, 98, or 95
- The latest NetWare 5 client software

To install the ConsoleOne 1.2 .DLL files and program icon on a workstation, complete the following steps:

1. Map a network drive to the SYS:PUBLIC\MGMT\CONSOLEONE\1.2\INSTALL directory.
2. Run the SETUP.EXE file.
3. Continue past the Welcome and License Agreement screens.
4. Specify the program folder in which you want to add the ConsoleOne 1.2 icons.
5. Verify the current installation settings and click Continue.
6. When the installation is completed, restart the workstation.

Running ConsoleOne 1.2 for the first time can be a bit tricky. Although the installation program installed a program group and a shortcut on your desktop, the group and shortcut are not functional yet. Before running ConsoleOne 1.2, you must first map a drive to the ConsoleOne program on the server. ConsoleOne is located in the SYS:\PUBLIC\MGMT\CONSOLEONE\1.2\BIN directory. You must use the same drive letter that you used to map a drive during the installation process. For example, suppose that you created the following drive mapping during the installation of ConsoleOne 1.2:

```
G:=SYS:PUBLIC\MGMT\CONSOLEONE\1.2\INSTALL
```

You must then create the following drive mapping before you can run ConsoleOne 1.2:

```
G:=SYS:PUBLIC\MGMT\CONSOLEONE\1.2\BIN
```

After creating this drive mapping, you should be able to refresh your screen, and the ConsoleOne icon should appear in the shortcut on your desktop. You can then launch ConsoleOne by double-clicking the icon.

CONCLUSION

NDS 8 is a giant leap for Novell, making its enterprise directory an ideal solution for the Internet and e-commerce. By providing massive scalability, NDS 8 takes Novell's directory into new markets such as huge global organizations, ISPs, and telcos.

But even if your organization doesn't fall into one of these categories, NDS 8 will benefit your company. In addition to providing more scalability and faster search queries, NDS 8 can give your company a competitive edge. Because the Internet is changing how we do business, it's hard to foresee what the future of e-commerce will hold. With NDS 8, however, you can build a directory today that is scalable enough to meet the future needs of your company as it extends to the Internet.

Sandy Stevens is a freelance writer based in Salt Lake City, Utah. She is coauthor of Novell's Guide to Integrating NetWare and NT, Novell's Guide to BorderManager, and Novell's Guide to NetWare Printing, available from Novell Press. ●

Good Help Is Hard to Find

Mickey Applebaum

Although managing your company's network can be difficult, finding reliable technical support may be even more challenging. You must distinguish between capable technical support providers and technical support providers who have little practical experience solving the networking issues your company faces. (See "The Role of Certification" on p. 40.)

This article offers a few guidelines that you can use to find reliable technical support for your company's network. This article first helps you evaluate the type of technical support your company needs. This article then helps you determine which potential technical support providers have the necessary skills to meet your company's technical support requirements.

TYPES OF TECHNICAL SUPPORT

Every network—regardless of its size, its location, and its hardware and software—eventually requires some type of technical support. To solve each problem, whether large or small, you must answer two critical questions: First, do you have the resources you need to solve the problem yourself? And second, who can you trust when you need outside help?

Before you can answer these questions, you must evaluate the type of technical support your company needs. There are three types of technical support:

- **Critical-Care Technical Support.** If you occasionally experience a problem that you cannot solve on your own, you can hire technical support providers on an as-needed basis. Technical support providers who offer critical-care technical support are similar to triage doctors who work in a hospital's emergency room.
- **On-Going Technical Support.** If you need help completing complex projects, such as implementing new technologies, you can hire technical support providers who offer on-going technical support. These technical support providers are similar to family practitioners who treat you for chronic conditions.
- **On-Site Technical Support.** If you need to supplement your company's technical support staff on a long-term basis but cannot hire additional employees, you can hire technical support providers who offer on-site technical support. These technical support providers are similar to home-care nurses who alleviate your workload while you are recovering from an illness.

Determining the type of technical support you need is the most important step in meeting your company's technical support requirements. In addition to considering the specific problem or project you face, you should consider other factors, such as the size and the experience of your company's technical support staff.

For example, suppose that you work for a small company and that network management is only one of your many job responsibilities. In this case, you may need all three types of technical support to ensure that you always have outside help whenever you encounter problems or implement projects that you are not equipped to handle. On the other hand, suppose that you work for a large company that has a full technical support staff. In this case, you may need only on-site technical support to ensure that you have an extra technical support professional who is dedicated to performing a long-term task.

You should also consider the cost of each type of technical support. Depending on the exact services you need, you may need to compromise to reduce costs. Obviously, if you cannot afford more than one type of technical support, you must choose the type of technical support that most closely meets all of your company's technical support requirements.

As you determine the type of technical support your company needs, you should be aware that technical support providers must draw the line somewhere. For example, you cannot expect a critical-care technical support provider to rush to your aid to add a new user to your company's network. Likewise, you cannot expect an on-going technical support provider who is implementing a database solution to restore a failed router.

You should also be aware that there is no better time than now to find reliable technical support. You should not wait until you are in the middle of a crisis.

TYPES OF TECHNICAL SUPPORT PROVIDERS

After you have decided which type of technical support you want, you must focus on finding an experienced technical support provider who provides this type of technical support. Sometimes the technical support provider you choose may be able to provide several types of technical support.

There are two types of technical support providers:

- Independent consultants
- Consulting companies

Most independent consultants provide reliable technical support in specific areas of expertise, often at a lower cost than consulting companies. On the other hand, consulting companies usually provide a broader range of services. And although consulting companies sometimes cost more, they may assign multiple consultants to your company's account. As a result, these companies can often provide more experience and faster assistance than independent consultants can provide.

The Role of Certification

When choosing a technical support provider, you should factor in industry certifications. Although you should not rely solely on industry certifications, you can use these certifications as a baseline for comparison. In other words, you may want to begin your search by considering technical support providers who have industry certifications. You can then narrow your search by evaluating the experience of each technical support provider.

Comparing the role of medical certifications and networking certifications helps clarify the relationship between certification and experience. Like technical support providers, medical students may receive one or more certifications in their field. To earn these certifications, medical students must engage in rigorous classroom training, learning the scientific theories behind medical procedures. Some medical students pursue a general certification, which covers a broad range of basic medical issues, whereas other medical students pursue a specialty certification, which covers specific medical issues surrounding a particular disease or area of the body.

Many technical support providers also pursue either general or specialty certifications. Technical support providers who pursue

general certifications want to address basic hardware and software issues. Technical support providers who pursue specialty certifications focus on a specific network component, such as routers.

With both doctors and technical support providers, you seek out a specialist if your problem is severe enough or complex enough to exceed a general practitioner's skills. However, there is one significant difference between the role of medical certifications and networking certifications: After their classroom study is completed, medical students are required to complete several years of hands-on training before they can become doctors. Technical support providers, on the other hand, usually begin working immediately.

Potential technical support providers who have earned certifications obviously believe in the importance of classroom training. In addition, they are willing to spend the time and the money necessary to pursue that training. But you should not assume that a technical support provider who has earned certifications knows how to solve every networking problem. Instead, you should gather as much information as you can about the provider's actual experience, and you should use this information to make your final decision. In short, when choosing a technical support provider, you should follow the steps outlined in the main article. ●

AVERTING DISASTERS

You should always ask several critical questions before choosing your technical support provider:

- How much experience does the technical support provider have with the type of network your company has, including the hardware and software used?
- Does the technical support provider guarantee availability?
- Does the technical support provider offer a single point of contact?
- Does the technical support provider offer a list of references, enabling you to contact both past and current customers for more information about the provider's quality of service?

Technical Support Experience

I have provided technical support for many years, and many of my customers came to me because their technical support provider could not help them. Most of these customers neglected to ask the appropriate questions before they hired their technical support provider.

The most important question to ask is the one about experience. Among other things, you should ensure that your technical support provider is familiar with the server platform and with the operating system your company uses. Otherwise, your technical support provider may be not be able to solve problems with which the provider has little experience. This situation

is especially common with independent service providers, who do not have a company full of colleagues to call for help.

To determine whether or not potential technical support providers have adequate experience, you should document your company's network, making a complete list of the hardware and software you use. You can then present this list to potential technical support providers so they know exactly what they are expected to maintain. This list can also help protect you from unscrupulous technical support providers who may try to convince you that you need unnecessary equipment or replacement parts, assuming that you are not familiar with each component in your company's network.

Guarantee of Availability

The speed with which your technical support provider responds to a service request may determine whether or not your company's network survives a system failure. For example, if a technical support provider cannot guarantee at least same-day response, you must evaluate the impact on your company if its network is down for a day or two—or possibly even longer.

In addition, you should find out whether or not potential technical support providers maintain their own supply of replacement parts. If a technical support provider does not stock replacement parts for the hardware you use, you may find yourself at the mercy of manufacturers'

warehouses and shipping services in the event of a hardware failure.

Single Point of Contact

Having a single point of contact may not seem important when your company's network is functioning properly. But when something goes wrong, you cannot underestimate the value of being able to contact a technical support professional who is familiar with your company's network.

A single point of contact is also useful if you are trying to juggle multiple projects simultaneously. In this case, your contact can act as a project manager, ensuring that each project is on track.

In addition, a single point of contact provides you with a technical support professional who can evaluate all of the services you are receiving and determine whether or not you are satisfied with these services. Otherwise, you may receive unsatisfactory services because no one is coordinating these services.

List of References

Nothing beats references when you are trying to find reliable technical support. You should always request a list of references from each potential technical support provider. This list should include contact information for several customers who are using or have used the same technical support provider and have received services similar to the ones you require. You should then contact these customers, en-

sureing that they have had a good experience with the technical support provider.

A reputable technical support provider should supply you with contact information both for customers who praise the provider and for customers who have experienced problems. You can then determine the technical support provider's strengths and weaknesses.

You can also use references from other companies to track down potential technical support providers. You may want to ask your company's partners, suppliers, and customers whether or not they are happy with their technical support provider. In addition, you can ask other network administrators, such as members of your local NetWare user group, if they have any recommendations. (To locate a NetWare user group in your area, visit the *NetWare Connection* web site at <http://www.nwconnection.com>.)

DOING YOUR PART

After you choose a technical support provider, you should ask what the provider expects from you. For example, I do not accept a new customer without first performing a basic health check on the company's network. This health check allows me to conduct an inventory of the hardware, software, and services that are running. I can also determine if all of the current patches and updates are installed.

Based on what I find during the health check, I know if I should accept the job. If the network's overall health is relatively good, I may accept the job because I do not have to spend an inordinate amount of time reconfiguring hardware and software and installing current patches and updates. If the network has significant problems, however, I may decide to reject the job because the extra work I am faced with may interfere with the time I must dedicate to my existing customers.

A reputable technical support provider may have a similar selection process, which helps ensure that the provider can properly support every customer. Technical support providers who are willing to take on any and every customer may eventually end up spending all of their time and resources with the one customer whose network is in the worst shape, leaving little time for the remaining customers.

CONCLUSION

Managing your company's network is only part of your job. You also have the

responsibility of finding reliable technical support—a process that requires you to do your homework. You must evaluate your company's technical support requirements and determine what type of technical support your company needs. In addition, you must interview potential technical support providers, asking them a variety of questions and checking their references.

If you complete these steps, you are far less likely to make your company the un-

witting victim in a technical support horror story. Instead, you may develop a successful technical support relationship that can serve your company well for many years to come.

Mickey Applebaum has worked with NetWare for more than 14 years. Mickey provides technical support on the Internet for The Forums (<http://theforums.com>) and operates Proactive Team Solutions, a consulting firm located in Salt Lake City, Utah. •



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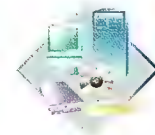
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Network Management Products

Kimberly Jones

If you are a network administrator, purchasing a solid network management product can make all of the difference between loving your job and contemplating a career change. You can't go wrong with the third-party, software-based network management products featured in this article. These network management products save you a significant amount of time and effort, while enabling you to get the most out of your company's NetWare network. (Novell also offers network management products that greatly simplify the management process. See "Network Management, Novell Style" on p. 44.)

UNICENTER TNG 2.2

Unicenter TNG 2.2 from Computer Associates International Inc. is a comprehensive network management product for heterogeneous enterprise networks. Unicenter TNG 2.2 supports multiple protocols, such as TCP/IP, IPX/SPX, Systems Network Architecture (SNA), and DECnet. Unicenter TNG 2.2 also supports multiple server and workstation platforms, such as NetWare 5, NetWare 4, NetWare 3, Windows NT, UNIX, AS/400, and mainframes.

With Unicenter TNG 2.2, you can manage nearly every type of network operation, including storage, security, and software distribution. In addition, you can manage network resources, such as systems, desktops, and applications. Unicenter TNG 2.2 includes the following features to help you take advantage of these management capabilities:

- **Real-World Interface.** Unicenter TNG 2.2 includes a real-world interface, which provides a 3-D graphical representation of the entire network. In addition to displaying network devices, this interface offers a real-time animated view of abstract objects, such as processes, databases, and print jobs. You can customize this interface to represent your company's network.
- **Business Process Views.** Unicenter TNG 2.2 includes business process views, which display information for

every component of a particular business process. These views allow you to manage entire business processes. For example, if your company's accounting system is slow, you can view all of the components that are related to the performance of this system to identify the cause of the problem.

- **Management Agents.** Unicenter TNG 2.2 includes intelligent management agents, which monitor and report the events that occur on your company's network. These agents also perform distributed storage and configuration management. You can deploy agents throughout your company's network, and you can even deploy agents in an Internet or an intranet environment.

You can purchase Unicenter TNG 2.2 through retail channels beginning at the suggested retail price of U.S. \$2,500. For more information about Unicenter TNG 2.2, visit Computer Associates' web site (<http://www.cai.com>). You can also call 1-800-CALL-CAI or 1-516-DIAL-CAI.

SYNCHRONICITY 2 FOR NETWARE 3

Synchronicity 2 for NetWare 3 from NetVision Inc. simplifies the process of managing a mixed network that contains NetWare 5, NetWare 4, and NetWare 3 servers. Synchronicity 2 for NetWare 3 supports pure IP, pure IPX, and a combination of both protocols.

With Synchronicity 2 for NetWare 3, you can migrate all user and group accounts from the NetWare 3 bindery to the Novell Directory Services (NDS) database. Synchronicity 2 for NetWare 3 even resolves naming conflicts that occur during the migration process.

You can then manage these accounts through Novell's NetWare Administrator (NWADMIN) utility by using the snap-in module that comes with Synchronicity 2 for NetWare 3. The snap-in module allows you to expand each NetWare 3 Server object in the NDS tree, displaying the user and group accounts that are located on that server. You can even create, modify, and delete user and group accounts without having to create an associated User or Group object in the NDS tree.

After any change is made to a user or group account, Synchronicity 2 for NetWare 3 automatically detects and synchronizes this change between the NDS database and the NetWare 3 bindery. To minimize synchronization traffic, Synchronicity 2 for NetWare 3 initiates the synchronization process only when changes occur. Synchronicity 2 for NetWare 3 further minimizes synchronization traffic by transmitting only the user or group account information that has been modified.

You can purchase Synchronicity 2 for NetWare 3 at the suggested retail price of U.S. \$14 per user account by calling 1-801-764-0400, extension 4. You can also download the 30-day trial version from <http://www.netvision.com/download/download.html>. For more information about Synchronicity 2 for NetWare 3, visit NetVision's web site (<http://www.netvision.com>). You can also call 1-801-764-0400.

MANAGE EXEC 5.5

Manage Exec 5.5 from Seagate Software automatically monitors more than a thousand events that occur on your company's network. For example, Manage Exec 5.5 monitors events on NetWare 5, NetWare 4, and NetWare 3 servers, such as events that are related to NetWare Loadable Modules (NLMs), SET parameters, connections, open files, and login scripts. Manage Exec 5.5 also monitors

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(925) 933-9955 x2846
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Network Management, Novell Style

Who knows NetWare better than Novell? If you are in the market for network management products, you may want to check out the following Novell products:

- **ManageWise 2.6.** ManageWise 2.6 is a network monitoring and management tool that is fully integrated with Novell Directory Services (NDS). ManageWise 2.6 offers network management capabilities such as NetWare and Windows NT server management, NDS monitoring, network traffic analysis, network health reports, network inventory, virus protection, early-warning alarms, and desktop management for a variety of workstation platforms. (You can order a free, 90-day evaluation copy of ManageWise 2.6 on CD-ROM at <http://www.novell.com/products/managewise/eval.html>.)
- **Zero Effort Networks (Z.E.N.works) 1.1.** Z.E.N.works 1.1 is an NDS-enabled network management tool that focuses on desktop

events on Windows NT servers, such as events related to memory, services, connections, open files, and event logs. In addition, Manage Exec 5.5 monitors applications that use performance counters.

Manage Exec 5.5 takes monitoring a step further by analyzing all of these events and generating detailed reports. Manage Exec 5.5 offers a range of reporting capabilities, including trend analysis, statistical charting, and capacity planning. These reporting capabilities provide both real-time and historical information about all statistics monitored by Manage Exec 5.5.

Manage Exec 5.5 also analyzes each server's behavior patterns and establishes performance baselines. Manage Exec 5.5 automatically sets server-appropriate alert thresholds and priorities based on this analysis. As a server's behavior patterns change over time, Manage Exec 5.5 fine-tunes the alert thresholds and priorities accordingly.

When a server crosses one of the alert thresholds, Manage Exec 5.5 alerts you to the problem via a pager message, an e-mail message, or a message sent to another Simple Network Management Protocol (SNMP) compliant network management system, such as Novell's ManageWise. In addition, you can view alerts and perform management tasks through a Windows NT management console. Manage Exec 5.5 also includes a web-based management console that you can access from a standard web browser.

You can purchase Manage Exec 5.5 through retail channels beginning at the

suggested retail price of U.S. \$895 per server. For more information about Manage Exec 5.5, visit Seagate Software's web site (<http://www.seagatesoftware.com>). You can also call 1-800-327-2232 or 1-407-531-7501.

LANDECODER NETWORK MANAGEMENT SUITE 1.0

LANdecoder Network Management Suite 1.0 from Triticom is a set of four integrated products designed to cover all of the network management bases. LANdecoder Network Management Suite 1.0 consists of the following products:

- **LANdecoder32.** LANdecoder32 monitors network operations and assesses network health. LANdecoder32 also offers extensive troubleshooting capabilities. For example, LANdecoder32 gathers and analyzes information that you can use to isolate networking problems. You can configure LANdecoder32 to display this information in real-time or to create a snapshot file that you can view later. You can also configure LANdecoder32 to generate traffic on the network, which may help you pinpoint exactly where a particular networking problem exists.
- **LANdecoder SNMP Manager.** LANdecoder SNMP Manager automatically locates and queries any network device with an SNMP agent. LANdecoder SNMP Manager then gathers information about the performance and status of that device. You can access LANdecoder SNMP Manager

and application management. With Z.E.N.works 1.1, you can create and manage policies and user profiles for Windows NT, 98, and 95 workstations from a central location. You can centrally distribute, update, and manage applications on multiple workstations. You can also monitor the year-2000 compliance of every PC on your company's network with Greenwich Mean Time's Check 2000. (Z.E.N.works 1.1 includes five free licenses of Check 2000.) You can download the Z.E.N.works Starter Pack, which includes some of the basic components of Z.E.N.works, at <http://www.novell.com/download>.

Novell plans to release additional network management products in the future. For example, Novell and Lucent Technologies have signed an agreement to develop NDS-enabled IP management solutions based on Lucent's QIP IP address management software.

For more information about Novell's network management products, visit Novell's web site (<http://www.novell.com>). You can also call 1-800-NETWARE or 1-801-228-4272. ●

by simply clicking a button on the LANdecoder32 screen.

- **LANdecoder Health Reporter.** LANdecoder Health Reporter offers a GUI that allows you to view the snapshot files created by LANdecoder32. LANdecoder Health Reporter converts these files into graphical charts, providing trend analysis.
- **RMONster32.** RMONster32 is a remote network monitoring (RMON) agent that supports RMON I and RMON II Management Information Bases (MIBs). RMONster32 offers a remote interface to other management stations within your company's network, enabling you to create a cohesive management system.

You can purchase LANdecoder Network Management Suite 1.0 through retail channels beginning at the suggested retail price of U.S. \$2,995. For more information about LANdecoder Network Management Suite 1.0, visit Triticom's web site (<http://www.triticom.com>). You can also call 1-612-937-0772.

CONCLUSION

Few products can make your job easier than network management products. If the network management product you are currently using does not provide a GUI with monitoring, analyzing, and reporting capabilities you can customize, you might want to shop around for a new solution. Your company's network may depend on it.

Kimberly Jones is a freelance writer and editor based in Chicago, Illinois. ●

NUI Leadership Summit

Chip DiComo

In many ways, NetWare Users International (NUI) functions as a network: NUI brings together network engineers, network administrators, and users, enabling them to share ideas about how to make a network run more smoothly. And just like a computer network, the NUI network needs some performance tuning every now and then. So every year, NetWare user group presidents and delegates from around the world attend the NUI Leadership Summit to receive leadership training, discuss ways to improve NetWare user groups, and receive the latest product and technical information from Novell.

This year, 151 NUI representatives converged in Salt Lake City, Utah on March 20–21 to attend the fourth annual NUI Leadership Summit.

SEMINARS AND WORKSHOPS

On the first day of the summit, NUI representatives participated in Franklin Covey training, which focuses on Stephen R. Covey's book, *The 7 Habits of Highly Effective People*. "The training was great," says Ray Osburn of the Utah Valley NetWare user group. "Even though the information [I] learned can't increase the amount of time in my day, it will help me balance my time better between work, [NetWare] user group activities, and my family."

Later that day, Dr. Eric Schmidt, Novell Chairman of the Board and CEO, addressed the NUI representatives. In his remarks, Schmidt reconfirmed Novell's commitment to its most loyal user base—NUI members. He gave a brief overview of the progress Novell has made in the past year and commented on future products and the direction of the company. Schmidt also answered questions and asked for suggestions from the NUI representatives.

On the second day of the summit, NUI representatives attended workshops on topics such as group management, membership recruitment, and educational programs. "This education is critical for all of us," says Esther Fleming of the South Florida NetWare user group. "Each president shares what works best for his or her group. Every year, I learn several new ideas to take back to Miami."

ONE STOP SHOPPING

For the first time, the NUI Leadership Summit was held in conjunction with Novell's BrainShare technical conference. As a result, NUI representatives who could take the extra time out of their work schedules were able to enjoy all of the benefits of Novell's premier technical conference. (For more information about BrainShare '99, visit <http://www.novell.com/events/brainshare>.)

For many NUI representatives, the opportunity to attend both the NUI Leadership Summit and BrainShare '99 made the week spent in Utah even more valuable. According to Stephen Walker of the Chattanooga, Tennessee NetWare user group, "BrainShare '99 was amazing. I received so many technical updates. I could present this material to my group over the next several meetings and still have material left over."

WELL WORTH THE EFFORT

NUI representatives left the NUI Leadership Summit with tools to build stronger NetWare user groups and with a better appreciation and understanding of Novell's products. As Dan Long, president of the Naples, Florida NetWare user group, explains, "The Summit gives me a chance to recharge, get some new ideas, and go back to my group full of energy for another year of activities. Sometimes, I

don't know how we do it," he admits. "These groups take a lot of effort, on top of doing our regular jobs, but the professional network we build is well worth the effort it takes."

If you are interested in joining a NetWare user group, now is a great time to become a member. To locate the NetWare user group nearest you, visit NUI's web site at <http://www.novell.com/nui>.

Chip DiComo is a board member of NUI, North America (NUI, NA). ●

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Digitalme

At BrainShare '99 in Salt Lake City, Novell announced its new digitalme initiative. Digitalme is Novell's solution to managing personal information, or *digital identity*, on the Internet. Digitalme leverages Novell Directory Services (NDS) to enable you to control and protect the distribution of personal information on the Internet.

Digitalme features a flexible software architecture that allows you to create, personalize, and manage *meCards*, virtual cards that provide information about your digital identity. You can designate which information located on your meCard is public or private, and you can then use your meCard to automatically sign on to web sites that require registration. For example, you can create a meCard that automatically completes identification forms on the Internet. When you try to access a web site that requires an identification form, digitalme's personal proxy system intercepts and completes the form and provides the completed form for your review. The next time you access the site, digitalme automatically handles the sign-in process.

Digitalme also improves privacy awareness by generating a log that identifies which sites have received your meCard information. The digitalme suite of services also supports instant chat features, messaging services, and document sharing capabilities.

Novell plans to offer digitalme free over the Internet in open source format within six months. For more information about Novell's digitalme initiative, see the article by Dr. Eric Schmidt, Novell chairman of the board and CEO, in the BrainShare '99 Conference Daily. You can download this article from http://www.nwconnection.com/brainshare/showdaily/mon_index.html. You can also watch for new information about digitalme on the digitalme web site (<http://www.digitalme.com>).

NetWare for SAA 4

Novell recently announced that NetWare for SAA 4, a LAN-to-host connectivity solution, is now available. NetWare for SAA 4, developed jointly by Novell and IBM Corp., enables you to integrate NetWare networks, company intranets, and Internet applications with IBM mainframe computers and AS/400 systems. NetWare for SAA 4 is fully integrated with NDS, allowing you to manage the NetWare for SAA 4 gateways from a central location.

NetWare for SAA 4 is also integrated with NetWare 5 and provides TCP/IP support, including gateway services such as load balancing and rollover support for AS/400 systems. In addition, NetWare for SAA 4 offers enhanced support for IBM's Systems Network Architecture (SNA) protocol, thereby providing high-performance routing (HPR) over TCP/IP. The result is faster and more reliable access to IBM host resources. NetWare for SAA 4 offers Secure Sockets Layer 3.0 (SSL) encryption, ensuring secure communication over the Internet and corporate intranets.

In addition to these features, NetWare for SAA 4 includes trial versions of the following products:

- IBM's Host On-Demand, a Java application that ensures secure browser access to host data and applications

- Novell's NetWare HostPublisher, server-based software that permits authorized users to access applications and data on IBM mainframes via corporate intranets, extranets, or the Internet
- IBM's Personal Communications 4.3, which provides Windows NT, 98, and 95 desktops with access to IBM mainframe and AS/400 applications

You can purchase NetWare for SAA 4 from any Novell authorized reseller. For more information about NetWare for SAA 4, call 1-888-321-4272 or 1-801-228-4272, or visit Novell's web site at <http://www.novell.com/products/host>.

Novell Internet Caching System

Novell recently unveiled Novell Internet Caching System, a scalable, plug-and-accelerate caching appliance architecture. Novell Internet Caching System dramatically speeds up the transmission of information on intranets, extranets, and the Internet. In addition, Novell Internet Caching System increases the capacity of any web server ten-fold.

Novell Internet Caching System allows you to implement a single caching solution in a mixed network environment. Novell Internet Caching System also provides an open-standards, Intel-based architecture that leverages your company's existing network infrastructure and reduces overall bandwidth consumption. In addition, Novell Internet Caching System offers advanced capabilities such as native and Layer 4 switch transparent proxy.

Novell Internet Caching System includes a high performance, scalable Cache Object Store with fault tolerance capabilities such as disk cloning, disk mirroring, and cache clustering. You can install Novell Internet Caching System on Cisco, UNIX, Windows NT, NetWare, or other switch and router environments in fewer than 10 minutes. Novell Internet Caching System is easy to manage from any location using standard management interfaces such as Telnet, FTP, web browser, and serial connection interfaces. Novell Internet Caching System also supports Simple Network Management Protocol (SNMP).

Novell Internet Caching System provides URL filtering and blocking as well as browser-based monitoring and logging of usage statistics. Novell Internet Caching System also allows you to perform over-the-wire upgrades.

Novell Internet Caching System licenses are available through Novell's Original Equipment Manufacturers (OEMs) that base their products on Intel architecture. For more information about Novell Internet Caching System, visit Novell's web site at <http://www.novell.com/products/nics>.

Novell Cluster Services for NetWare 5 Open Beta

Novell recently announced that the open beta version of Novell Cluster Services for NetWare 5 is now available. Novell Cluster Services for NetWare 5 is a multinode clus-

tering solution that leverages NDS and Novell's ConsoleOne Java management tool to simplify the administration of clustered resources within a network. Novell Cluster Services for NetWare 5 greatly increases the availability of web and Internet application servers for e-business storefronts and other transaction-oriented industries.

Novell Cluster Services for NetWare 5 uses shared disk array technology to eliminate the downtime that results from hardware or software failures. This technology ensures that if a clustered server fails, applications and users running on that server are transparently migrated to another server in the cluster.

Novell Cluster Services for NetWare 5 provides application fan-out: Application fan-out allows you to redistribute any applications that reside on a failed server to other servers in the cluster. In addition, Novell Cluster Services for NetWare 5 provides application fan-in, allowing you to consolidate applications from multiple failed servers to surviving servers in the cluster.

Novell Cluster Services for NetWare 5 also provides automatic reconnect features, which enable transparent migration of IP-based clients from failed servers to surviving servers in the cluster.

You can download the open beta version of Novell Cluster Services for NetWare 5 at <http://support.novell.com/beta/public>. For more information, call 1-888-321-4272 or 1-801-228-4272, or visit Novell's web site at <http://www.novell.com/products/clusters>.

6 Pack and Modesto

Novell has announced two new NetWare products, code-named 6 Pack and Modesto, that will provide next-generation, web-based networking services in the near future.

6 Pack, which builds upon the features of NetWare 5, will provide enhanced network performance, scalability, and management capabilities by enabling all of NetWare's core networking services to take advantage of multi-processors. 6 Pack will also incorporate NDS 8, which enables companies to manage millions of objects reliably and securely on one server.

Modesto is Novell's 64-bit server operating system that is designed to run on Intel's upcoming IA-64 processor family, beginning with the Merced processor. Novell will be the first vendor in the computer industry to demonstrate an application and 64-bit server operating system on a Merced software development environment.

Novell and Intel are working toward a simultaneous release of Modesto and the Merced processor during mid-2000.

Managed VPN Services

Novell and Apex Global Internet Services (AGIS), a global multimedia and data communications company, recently announced a partnership to develop directory-enabled Internet services for enterprise networks. These services will enable companies to receive secure, reliable, and rapid data service from a single source, such as a local exchange carrier or an

Internet service provider (ISP). As the first step towards delivering these services, AGIS will soon release a managed Virtual Private Networking (VPN) solution, which bundles NDS and Novell's BorderManager VPN Services 3.

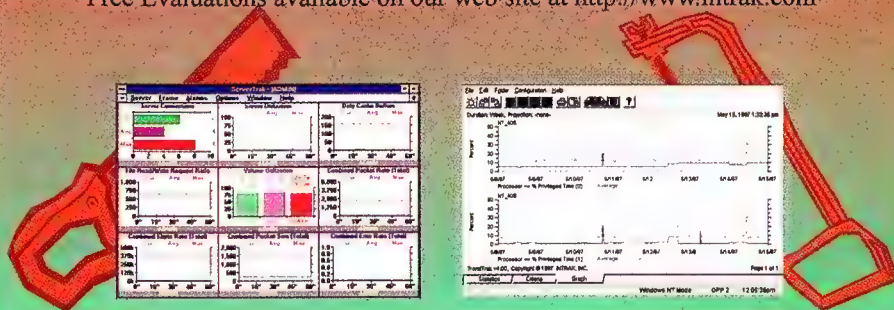
Because this managed VPN solution is based on NDS, you can manage and coordinate user information, company policies, network configuration specifications, and network addresses through a single, distributed directory.

NDS also provides a single data source. In addition, NDS allows you to assign a single username and password to users. As a result, remote users, telecommuters, and roaming users have secure access to your company's network regardless of their location.

To read the press release announcing the managed VPN solution, visit AGIS's web site at <http://www.agis.net>. You can also call 1-800-380-AGIS or 1-313-730-1130. ●

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Get With the Program

Matthew Jones

Now that the Internet provides everything from stock quotes to weather forecasts, it's easy to forget that one of the original purposes of the Internet was to serve as an open forum for programmers. By visiting the web sites featured in this article, you can find a range of programming information, whether you are a novice or an experienced programmer. You can then check out this month's network resources, which offer support for NetWare developers. You can also take a look at this month's games, and you can read about the new products I have found. (See "Product Snapshots.")

WEB SITES

If you are looking for programming utilities, Programmers' Heaven (<http://www.programmersheaven.com>) is the web site for you. At Programmers' Heaven, you can download hundreds of shareware and freeware programming utilities for several programming languages, such as C++, Visual Basic, and Java. You can also download programming utilities that allow you to create games or to add sound capabilities to the software you are developing. In addition, you can access even more programming resources by purchasing a set of two CD-ROMs. These CD-ROMs contain more than 12,000 programming utilities, source codes, components, routines, help files, and examples.

WebKnowHow.net (<http://www.webknowhow.net>) provides programming resources for developers who want to write web-based software or to incorporate web-based features into other types of software. For example, you can download programming utilities and tools, including Common Gateway Interface (CGI) scripts and Java applets. You can even access programming tutorials, such as tutorials about optimizing graphics and creating online databases. You can also read programming articles, such as articles about using Server Side Include (SSI) commands and integrating effective designs with HTML codes.

If you still have programming questions after you check out these resources, you can submit your questions through Inquiry.com (<http://www.inquiry.com>). Inquiry.com offers free forums that are monitored by professional developers who can answer your questions about application, database, and web development. These forums allow you to submit programming questions about various platforms, including Windows, Informix, and Java. You can read descriptions and reviews of more than 5,000 programming utilities. You can also find information about upcoming developer-related events, and you can browse developer-related job listings.

NETWORK RESOURCES

If you haven't visited Novell's DeveloperNet (<http://developer.novell.com>) lately, what are you waiting for? DeveloperNet is an essential web site for anyone who is interested in developing soft-

ware that works with Novell products. You can download free development tools, such as the Novell Developer Kit, which includes components to help you develop software that works with a particular Novell product, such as NetWare, Novell Directory Services (NDS), BorderManager, or GroupWise. To minimize download time, you can download only the pieces of the Novell Developer Kit that you need.

You can also read the latest issues of Novell's *DeveloperNotes* and *AppNotes* online, and you can access an archive of back issues. In addition, you can view a complete list of products that have earned Novell's Yes, Tested and Approved certification, and you can find out how to submit your own software for testing and certification. You can even find out how Novell is helping developers market their products, and you can view a calendar of upcoming developer events.

STANDALONE GAME OF THE MONTH

RollerCoaster Tycoon from Hasbro Interactive is a simulation game that allows you to design and manage a virtual amusement park. First, you must lay paths, garbage cans, and benches. You must also build rest rooms, and you must provide places for guests to buy something to eat and drink. Depending on the terrain, you might even have to remove trees and to raise or lower land.

The next step is to build some rides. You have many rides to choose from, including a Ferris wheel, a haunted house, and a log flume. Of course, the centerpiece of RollerCoaster Tycoon is the advanced construction engine that allows you to create a variety of roller coasters. You can create an ordinary wooden or steel roller coaster, or you can create more complicated roller coasters, such as bobsled, corkscrew, and suspended roller coasters. You can use a preexisting design, or you can design your own roller coaster, creating as many twists, turns, and drops as you want.

The success of your amusement park is determined by how many guests you have at the end of the game. To attract guests, you must specify a reasonable admission fee, and you must create a pleasant atmosphere by hiring entertainers, handymen, and security guards. You can also initiate several types of marketing campaigns, including advertisements and vouchers for half-price tickets. You can also dedicate money to research and development, enabling the invention of state-of-the-art rides.

RollerCoaster Tycoon supports Windows 98 and 95. You can purchase RollerCoaster Tycoon through retail channels at the suggested retail price of U.S. \$39.95, and you can download a demo version from <http://www.rollercoastertycoon.com/test>. (You can also download additional rides from this web site.) For more information, visit the official RollerCoaster Tycoon web site (<http://www.rollercoastertycoon.com>). You can also call 1-800-400-1352.

Product Snapshots

When I am surfing the Internet, I often find new and interesting products. Product Snapshots gives you an overview of the most useful products I have found during the last month. (Please note that these are first-look reviews.)

NORTON GHOST FOR NETWARE

Norton Ghost for NetWare from Symantec Corp. is a software product that allows you to duplicate entire NetWare volumes, NetWare partitions, or hard drives for any NetWare 5, 4.x, or 3 server. This capability simplifies the process of upgrading hard drives or migrating data from one server to another. In addition, this capability allows you to create a complete backup quickly and easily.

Norton Ghost for NetWare creates an image file that contains all volume, partition, or hard drive information. Norton Ghost for NetWare then copies the image file from the source hard drive to the target hard drive, without requiring you to install NetWare on the target hard drive. The source and the target hard drive can be located in the same server, or they can be located in different servers that are connected via a network running TCP/IP.

You can also copy image files to removable storage media, such as Zip disks, Jaz disks, or CD-ROMs. You can even split a single image file across multiple disks or CD-ROMs. In addition, you can copy image files to and load them from backup tapes.

One of the best features of Norton Ghost for NetWare is that the source and the target hard drive do not have to be the same size. Another useful feature is that only the necessary volume, partition, or hard drive information is saved to an image file. As a result, Norton Ghost for NetWare does not copy the volume, partition, or hard drive information on a sector-by-sector basis, which requires a lot of time and space.

Norton Ghost for NetWare is scheduled for release sometime this quarter. You can download a beta version from <http://www.ghost4nw.com/evaluation>. Symantec has established pricing for Norton Ghost for NetWare but has not yet released pricing information. You can get information about pricing and additional product information by calling Symantec at 1-800-745-6054 or 1-541-334-6054. You can also visit the Norton Ghost for NetWare web site (<http://www.ghost4nw.com>) for more information.

NETWORK GAME OF THE MONTH

X-Wing Alliance from LucasArts Entertainment Co. is the latest action game based on the *Star Wars* movies. If you can't wait to see the next *Star Wars* movie opening later this month, playing X-Wing Alliance may just tide you over until then.

As the game begins, you assume the role of a member of the Azzammen family, the owners of a thriving shipping business. You and your family are drawn into a conflict between the Empire and the Alliance, and you choose to fight with the Alliance. You then participate in battles while helping your family with their shipping business. For example, you fight in the historic Battle of Endor

against the Death Star, and you spy on your family's main competition, the Veraxo family. You also fly rescue and smuggling missions in the heat of battle.

In the course of these missions, you fly several types of starships, such as the Millennium Falcon, an X-Wing fighter, and a Corellian transport ship. Each starship features a 3-D cockpit, which provides a 360-degree view inside and outside the starship. A 3-D hangar serves as your base of operations. Because X-Wing Alliance supports a screen resolution of up to 1600 x 1200, the 3-D graphics are clear and realistic.

You can play X-Wing Alliance with one other person over a modem or a

serial connection. You can also play with up to three other people over an Internet connection or with up to seven other people over a network connection.

X-Wing Alliance supports Windows 98 and 95 and is available through retail channels at the suggested retail price of U.S. \$49.95. You can download a demo version from <http://www.lucasarts.com/products/alliance>. For more information, visit the LucasArts web site (<http://www.lucasarts.com>). You can also call 1-888-LEC-GAMES or 1-415-507-4545.

Matthew Jones is a manager in the e-commerce practice group of Waterstone Consulting, a business consulting and systems integration firm located in Chicago, Illinois. ●

DS EXPERT 2.7

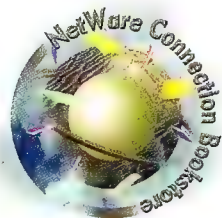
DS Expert 2.7 from NetPro Computing Inc. is a software product that allows you to monitor the status of your company's Novell Directory Services (NDS) tree. DS Expert 2.7 provides a graphical view of your company's NDS tree, enabling you to quickly ascertain the health of the NDS database. If DS Expert 2.7 detects any problems with the NDS database, including synchronization errors, you can troubleshoot these problems from a central location.

DS Expert 2.7 consists of three components that work together to gather and analyze NDS information:

- **DS Expert Agent.** The DS Expert agent is a NetWare Loadable Module (NLM) that runs on each server with an NDS partition. The DS Expert agent running on each server collects data about that server's partition and sends an alert to the Windows client if the partition has any problems.
- **Tree Monitor.** The Tree Monitor is an NLM that runs on a single server, gathering data from all of the DS Expert agents and using this data to analyze the status of the NDS database.
- **Windows Client.** The Windows client runs on a single Windows 98, 95, or 3.x workstation. The Windows client provides a centralized management interface, displaying a graphical view that shows the real-time status of the NDS database. You can view detailed information about servers, partitions, and replicas in the NDS tree, including alerts generated by the DS Expert agents. You can also view statistics about the NDS database. For example, you can view the average number of NDS transactions that have occurred on a particular server during a specific length of time.

You can use DS Expert 2.7 alone or in conjunction with Novell's ManageWise via Simple Network Management Protocol (SNMP). DS Expert 2.7 also offers Management Information Base (MIB) support for other SNMP-based management products, such as IBM's NetView and Hewlett-Packard's OpenView.

DS Expert 2.7 supports NetWare 5 and 4.x. You can purchase DS Expert 2.7 through retail channels at the suggested retail price of U.S. \$12 per User object. You can request a free evaluation copy at <http://www.netpro.com/survey/novellwiz2.asp>. For more information, visit NetPro Computing's web site (<http://www.netpro.com>) or call 1-800-998-5090 or 1-602-941-3600. ●



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This guide tells you how to implement a pure IP network, configure TCP/IP on different NetWare clients, internetwork NetWare 5 clients, manage DNS servers, set up an FTP server, build a web server, and more.



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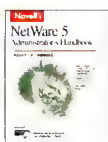
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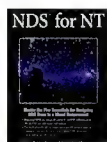
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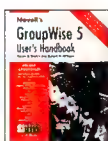
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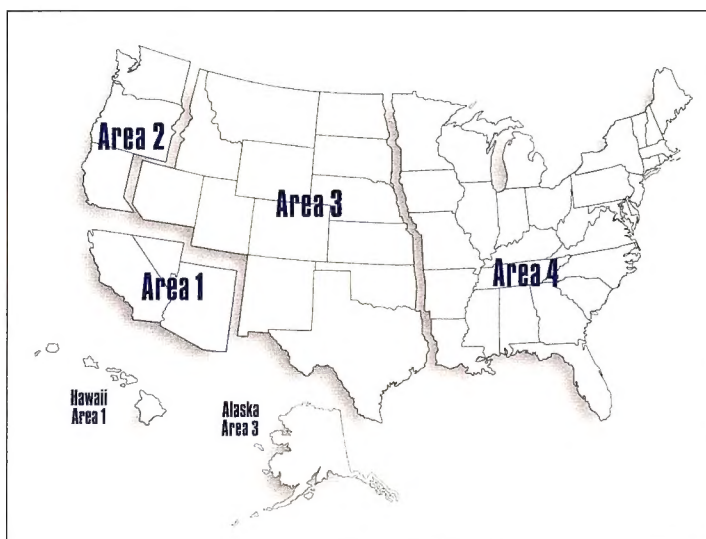
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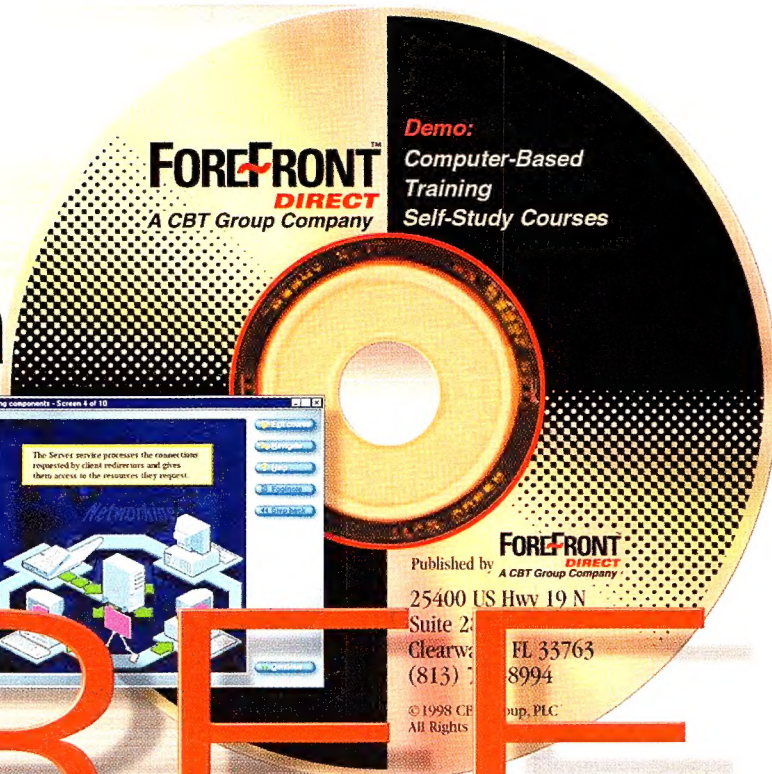
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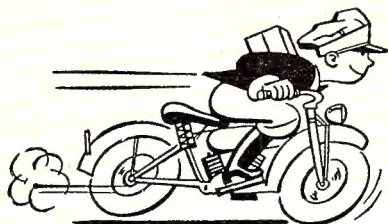
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